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Engineering News-Record

Repairing Cracks in Butte, Montana, Reservoir

Water-Works Articles In This Issue

Additional Mountain Water-Supply for Flagstaff, Ariz. — Corn Products Water Supply and Underground Pumping Station — Operation of Slow Sand Filters at Hartford — Open End Flume Water Meter Based on the Exponential Equation — Typhoid, Water Supply, Carriers and the Courts — Water Supply and Sewerage at State Institutions

In Addition

Six pages are devoted to "Job and Office" hints for water-works men

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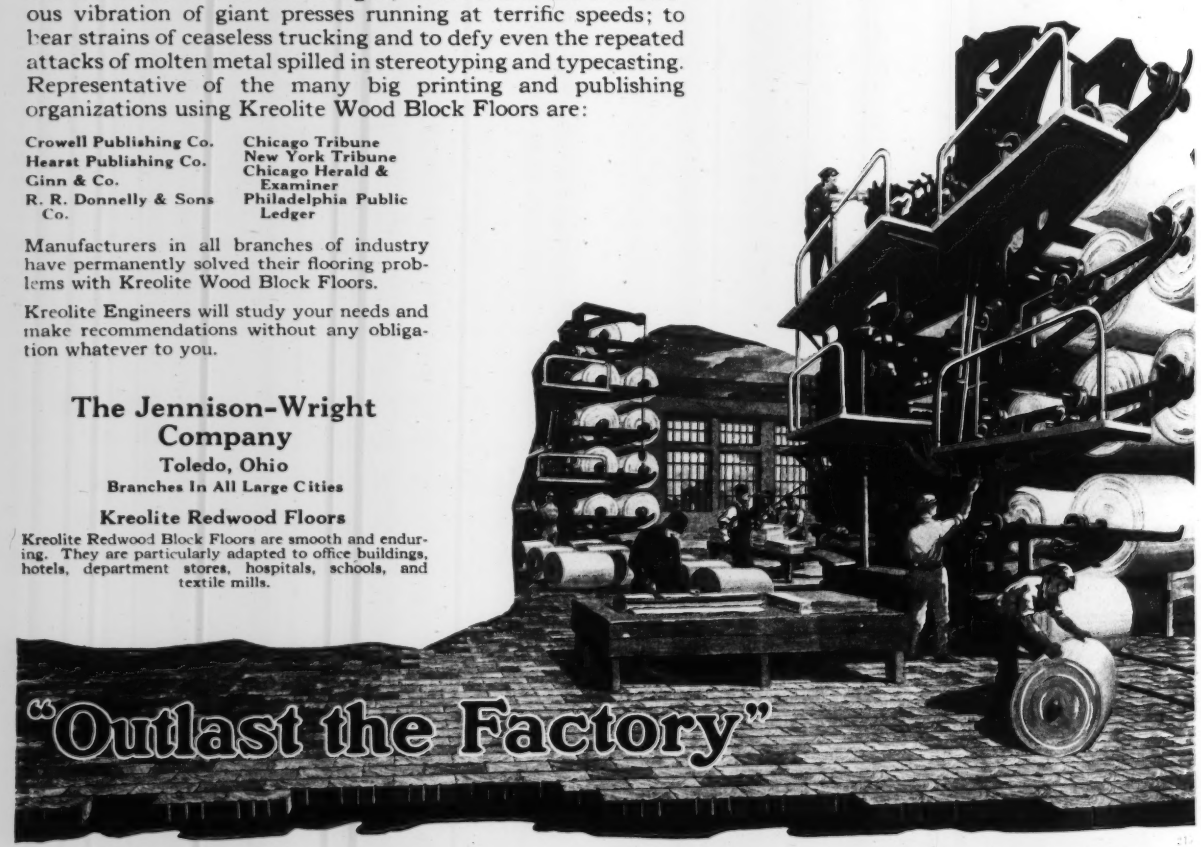

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 93 NEW YORK, SEPTEMBER 25, 1924 Number 13

Convention Date Conflicts

TO ALL except those responsible for the choosing of convention dates it seems inexcusable that hardly a year passes without confronting engineers with the necessity of choosing which of two widely separated conventions of importance to them held on the same dates they will attend. Next week the alternative is the New England Water Works Association at Rochester, N. Y., and the American Society of Municipal Improvements at Boston. It is only fair to say that the N. E. W. W. A. date was originally set for this week and hotel arrangements made accordingly, the Rochester people either forgetting or not knowing that there would be a state political convention in Rochester this week. There already being too much politics in water-works management it was wisely decided not to add more. In view of the conjunction of convention dates our issue of the present week contains more than the usual number of articles on water-works and other municipal subjects, and our issue of Oct. 9 will contain reports of both conventions and original contributions of special interest in the municipal field.

Pittsburgh Plus Ended

ACCEPTANCE of the Pittsburgh Plus findings and order of the Federal Trade Commission by the steel manufacturers puts at rest rumors that the U. S. Steel Corporation intended to fight the order by appeal and litigation. This decision of the manufacturers will find general approval. It was slow in coming; one might fairly expect the acceptance of such a quasi-judicial verdict to be announced immediately, instead of nearly two months afterward. Now that it has been made, however, it indicates the wise conclusion of the heads of the steel industry that it is unsound practice to continue business methods which have been publicly shown to be unfair. The announcement suggests, moreover, that it is the intention to carry out the spirit of the order without attempting to perpetuate the old system in part by indirection—which probably could be easily managed. The decision removes from the steel business the definite shadow of uncertainty which necessarily accompanies a contest over a decided change in price system. Readjustments will result from the new practice of quoting prices at the mill. These can now take their course during a period of moderate activity in the steel industry, when they will be less disturbing than during a boom or a slump. The first result of the new system should be a spreading of steel-using industries, which is just as favorable to the wellbeing of the country as the spreading of agriculture. The development of steel making on the basis of natural economic conditions rather than according to the dictates of tradition is likely to be a more gradual consequence, but an inevitable one. Free marketing should give the nearest practicable approach to the ideal that steel plants are best situated at the center of gravity of ore, fuel, labor and market.

Poor Water Service Penalized

THE seriousness of the water-supply situation in northeastern New Jersey has been further emphasized by two rulings of the New Jersey Utilities Commission within the past few months. Both these penalize the two companies supplying many cities and towns in the Plainfield-Elizabeth district by requiring the companies to give a discount of 10 per cent on their water bills until an adequate service is rendered. Rate increases, subject to this discount, have been granted to each company but not to the extent sought, and subject to the discount mentioned. The companies are the Plainfield-Union Water Co., which serves 16 municipalities in Somerset and Union Counties, and the Middlesex Water Co., affiliated with the other one. In the first case the commission made a declaration of more than local interest, the gist of which is that the company cannot be permitted to charge for an inadequate service, which it has not used due diligence to remedy, rates which would be allowable for adequate service. The commission did grant rates which it believes will afford a return commensurate with the service now afforded and enable the company with reasonable effort to finance needed improvements. Hope is held out for higher rates when the works are improved. In the other case it is reported that as lately as 1920 the Middlesex Water Co. declared a 36 per cent stock dividend—in 1913 its dividend was 9 per cent—and that it has paid from 6 to 8 per cent every year since then—at the latter figure every year since 1920. The backwardness of these communities in looking after the adequateness of their water supplies has long been surprising. That they do not band together either to obtain adequate supplies from the companies or else to establish municipal ownership can be explained only by inability to work together to a common end regardless of political or private interests.

Adventures in Water Engineering

IN A country so large in area and so diversified in geology and topography as is the United States there is bound to be a great variety in sources of water supply, water treatment and various elements of design and construction. This is well illustrated by several articles in the present issue. One of these deals with a New England surface water supply, impounded in large reservoirs. In line with modern progress, and in advance of general practice in New England for so safe a water, filtration was decided on. The choice was slow sand filters. Operating results, including color removal, given in Mr. Saville's article on the Hartford filters, will be all the more welcome because of the growing uncommonness of new installations of slow sand filters. Two articles in this issue deal with underground supplies: One describes interesting tunnel and other work in Illinois to connect up a number of wells whose yield, as delivered by air-lifts, had become inadequate. The other tells of extensions to a gravity

spring-water supply derived from a cinder-cone area or basin in the mountains above Flagstaff, Ariz. These three articles and several shorter ones in our current Job and Office section are but examples of the many adventures in water supply engineering throughout the length and breadth of the American continent that deserve to be put on record.

Virile American Science

IT WAS a fine testimonial to the virility of American science that was paid in the celebration at Philadelphia last week of the centenary of the founding of Franklin Institute. Such an assemblage of leaders in scientific research is rare on American soil. They came from the Old World, from the lands of older culture, to bear testimony to the quality of American scientific achievement. It was an inspiring gathering and lifted scientist and engineer (the applied scientist) to new levels of appreciation of the strong forward march of science, and America's contribution thereto.

Mention of the foreign leaders must not be thought a reflection on our own men. Indeed not, for the visitors came to pay tribute not to something abstract or to a system, but to men—men whom they are proud to call "colleagues" in the exploration of nature's mysteries. A nation that can claim an Elihu Thomson, a Michelson, a Langmuir, a Milliken, a Coolidge, a Mendenhall—to name but a very few—need not take second place in any estimate of scientific competence and accomplishment.

Dr. F. Haber, of nitrogen-fixation fame, expressed the visitors' thoughts with rare grace when he said at the closing banquet: "It is not now the congratulations of the wise teacher to the aspiring pupil that I extend. It is the respect of the older expert for the independence and splendid results accomplished by the younger colleague."

Of this testimony at the Institute Centenary, America may well be proud. Often there has been individual testimony, and never more so than when overseas scientists have come here to present the best fruits of their efforts or have invited our men to go abroad to tell of American accomplishment. But at Philadelphia there was emphasis and concert in overseas commendation. It should raise our appreciation of our own scientific achievements.

Comment on the Franklin Institute Centenary celebration would not be complete did it not express admiration of the Institute's work. For a century now it has been carrying out its purpose of encouraging development of the pure and applied sciences and of furnishing a vehicle through which discoveries and advances could be given to the educated public, and particularly to the people of Philadelphia. So well has its work been done that men of the first eminence accept its invitation to present papers. The people of Philadelphia are the gainers. In other cities are many specialist societies before which developments are chronicled, but we know of no local organization that has so successfully brought physicist and chemist and engineer together, and offered the public the means of meeting these various minds.

Engineering News-Record offers its congratulations on the fulfillment of one hundred fruitful years and its ardent wishes that the Institute may grow to still larger success.

Another Blow to Reclamation

F. E. Weymouth's resignation from the position of chief engineer of the U. S. Bureau of Reclamation is a new blow to the cause of efficient and honest land reclamation, adding to the shock which resulted from the dismissal of director A. P. Davis last year. The practice of sound governmental administration and the general public interest are again losers. Taken at its best, the event shakes the faith of those who believe that government service can offer a lasting and satisfying career to men of ability. Taken at its worst, it testifies to the continued activity of the malign influences that some time ago set out to destroy the Reclamation Service, one of the most efficient branches of the federal government, by political intrigue.

The resignation followed a year of nagging persecution of the engineers of the Reclamation Service. A spy system, investigations, subversion of operating system, frivolous and ignorant charges, threats of dismissal, were among its items. The procedure of Secretary Work, who personally arranged and directed the system, was of a kind to discourage and gall the best intentioned, and to make every serious effort futile. High praise is due the men of the Reclamation Service for their steadfastness during more than a year of these depressing conditions.

Mr. Weymouth's decision to leave the Service is the natural sequel of the discouragement and disorganization that have been deliberately brought about. It is reported that he will receive a higher salary in private employ. That is not surprising, for the quality of his work and that of his colleagues has been such as private industry rewards more richly than the government. But the engineers of the Reclamation Service have worked for more than money—for satisfaction in their important tasks, realizing their obligation to the people and to their organization. Mr. Weymouth was tied to the Reclamation Service more strongly than by bonds of employment and salary. He knew that his organization looked greatly to him for the inspiration of example and loyalty. He was not one to value this responsibility lightly, and we feel certain that he would have stayed to carry out his trust had Secretary Work accorded him a fraction of the support and sympathetic help to which he was entitled. That he was not given this support, and that he was harassed and persecuted instead, is sorry testimony to the Secretary's often praised organizational ability—if indeed he wished to keep the engineering service alive and efficient.

Early last year, when Secretary Work, soon after taking office, dismissed Arthur P. Davis, the experienced director of the Reclamation Service, his denunciation of engineers and the engineering conduct of the Service was discounted as a mere gesture to justify his attitude toward Mr. Davis. But the Secretary's course of action since then does not support this view. It has been made clear that his hostility is directed against the entire engineering organization and that he is moving straight in the direction of wrecking the Service completely. We are confident that the new commissioner of reclamation, Elwood Mead, while mainly occupied with the dual task of improving economic conditions on the projects and laying a foundation on which future reclamation could be undertaken, has appreciated fully the excellence of the engineering organization and the importance of maintaining that organization in efficient condition.

But apparently pernicious meddling from above has neutralized many of his efforts.

Every day's continuance of these nefarious activities means further injury and loss not merely to the engineering division, and to the profession generally, but direct loss to the people who live on reclamation and who hope for its future. The Western farmers and the national investment which they are administering are losing steadily under the Work régime. Engineers as professional men may feel deepest concern over the fact that a highly trained organization developed during two decades and representing a value impossible to estimate is disintegrating, after the spirit on which its strength depends has already been destroyed. But for engineers as citizens, and for citizens generally, it is more important to realize that a dark future lies before reclamation and the extensive public interest connected with it.

In this depressing situation the pleasure remains of knowing that Mr. Weymouth goes with the wholehearted confidence and good wishes of all who know him. May he find his new field of work as rich in opportunity and as favorable to the development of effective effort as the old.

Water-Works Management and Finance

THE public water supplies of the country have an enviable place among the utilities and municipal engineering services. In age, extent and efficiency and in their vital relations to health the water service ranks first. How is this premier position to be maintained and, regardless of any question of rank with the other municipal services, how are our public water supply systems as a class to attain even higher standards than have been maintained by the best of them in the past? We believe the answer rests more largely upon efficiency in general administration and finance than sound engineering design, construction and operation. Not that we depreciate the importance of sound engineering, for that is vital. We mean that it stands ready to serve in the future, as it has served when given a chance in the past, and that its future chance of rendering the service it is equipped and eager to give depends upon increased municipal administration and financial efficiency.

Hope for this betterment is warranted by the recent vast increase of attention given to both the theory and practice of municipal government. What the water-works service needs most of all, where it has not already got it, is (1) freedom from partisan politics and (2) to be allowed to stand on its own bottom.

There is no magic formula for the first. It depends rather upon the civic sense and common sense of the voters. It may be helped by certain charter provisions, such as "non-partisan" primaries and elections and civil service, especially of the sort that follows up the choice of men supposed to be capable of efficiency with checks on efficiency after appointment.

By the tub comparison, or allowing the water-works to stand on its own bottom, we mean water rates and a budget and back of the budget a method of financing construction costs that will make the water-works not only stand on its own bottom but that in addition will not permit some of its bottom to be taken away to support other municipal services. Rate making is greatly simplified and a water-works rendered more efficiently and more readily self supporting where the universal meter system prevails. First-cost financing can be lightened, in the long run, by restricting the life of bonds to that of the improvement, by serial rather than long-term bonds—both of which approved practices are happily becoming more common each year. Another possible way of lessening the financing of first cost is to collect a considerable part of the cost of lateral main extensions from abutting property owners. Where this is done attention should be given to distributing the cost on the true assessment-for-benefit plan rather than on some arbitrary pro rata front foot plan, or else pretense at the assessment plan should be given up.

As many water-works superintendents and commissioners know to their sorrow, water revenues are often robbed for the benefit of other city departments, and the water service, if not crippled, put on a precarious basis. This is not only damaging or at least likely to be so at any time, but it is unjust to the water consumer, who should not have his water bill increased to ease taxes for sewers or pavements or the health department.

Water-works management is a tempting field for discussion. So far as day-by-day and hour-by-hour management are concerned, the rapidly growing percentage of engineers on water-works staffs is pleasing witness to an increasing recognition of the value of engineering knowledge and experience in this field. Engineer-commissioners as well as engineer-superintendents and bureau heads are gaining in relative numbers. But there are questions of importance beyond and above these matters of personnel. Thus, in New England and some other parts of the country water boards were once common. Some of these have gone with the sweep of the commission plan and more will go with the present rapid extension of the commission-manager plan. Independently of the progress of these plans, water and other boards have been replaced in considerable numbers by single commissioners. In all three cases the abolition of water boards is a result of the growing belief that efficient administration demands a single general, as the allies finally learned in the late war. For some time to come, no doubt, the old water boards, often with long records of devoted and, on the whole, efficient service, will continue to go. Under plain commission charters this means that, theoretically, the water department is merged with all other departments so far as control of finances and general policies go, while in point of management it is under a single department head. The practical exigencies of such a mixed system often result in one-man control of both legislation and management. With the commission-manager plan, there is a separation, absolute in theory and largely so in practice, between legislative control and management. A comparative study of results under the three plans—water board, commission, and commission-manager—would be interesting, perhaps highly probable, but certainly difficult. A complete survey would require study of two other schemes—the water board under more or less control of a mayor and council and the council-committee plan of general control, with a superintendent or other single executive officer in charge of detailed management.

Whatever theory of management may prevail it is certain that the sanitary and executive engineer will in the future be the man on whom the health, safety and pocketbooks of the citizens will depend.

Water and Sewerage Construction at State Institutions by Maryland Department of Health

State Bureau of Sanitary Engineering Designs and Builds Water Supply and Purification Plants and Sewerage Systems and Sewage-Works—Institutions Pay for Service

By George L. Hall
Division Engineer, State Bureau of Sanitary Engineering.
Baltimore, Md.

Contribution from Bureau of Sanitary Engineering, Maryland State Department of Health, Abel Wolman, Chief Engineer

THE DESIGN and construction of water-supply and sewerage systems at state institutions in Maryland under the direction of the Bureau of Sanitary Engineering of the State Department of Health is sufficiently unusual in health department practice to warrant a brief presentation of certain features of the work which are of more than local interest. In order that institutional authorities might have engineering guidance in solving their water-supply and sewerage problems, the provision of delegating to the State Board of Health the duty of preparing plans for these systems, upon order by the governor or the legislature, was included in what is known as the water-supply and sewerage law of 1914.

As the annual appropriation of the State Board of Health does not provide for increased engineering services to perform the additional duties incident to this work at the institutions, it has been the policy to charge to each institution, where the bureau carries out such work, the actual cost for the time and expenses of the men employed on the work, plus 15 per cent of the amount of personal services, to cover stenographic services, use of materials and equipment and engineering supplies. In no instance has it been possible to carry on all this special work with the limited personnel of the bureau. It has been necessary, therefore, to employ temporary assistants, who are paid, as a rule, by the institution being served.

A summary of the work performed under this special provision of the law is given in Table I. The total cost of work completed to 1924 is $227,496, not including engineering costs. Engineering amounted to $24,404 or 9.6 per cent of the total. The only work done entirely by contract was at the Colored Tuberculosis Sanatorium, where the cost of engineering was only 6.2 per cent of the total cost. The bureau, acting in its capacity as engineer, purchases all materials and hires labor, except where the work is done by contract, so that part of the costs which have been charged against engineering is actually chargeable against construction.

From past experience it is believed that all water-supply and sewerage work at state institutions may be carried on with less cost to the state if all improvements are developed under the bureau's supervision. As has been pointed out in the annual reports of the bureau for 1916 and 1922, it is believed that a special fund should be provided for improving sanitary conditions at state institutions, subject to the control of the State Board of Health. With such a fund available the bureau might proceed with improvements whenever necessary, without waiting for favorable action by the legislature. In this way advantage might be taken of low markets for purchasing materials. In addition, each state institution should contribute annually a nominal sum to a fund which would enable the bureau to supervise more care-

TABLE I—WATER SUPPLY AND SEWERAGE CONSTRUCTION WORK AT STATE INSTITUTIONS
Executed Under Plans and Supervision of Maryland State Department of Health

Institution	Population	Nature of Work	Date Installed	Description of Works	Cost: Construction	Cost: Engineering and Supervision	Remarks
Springfield State Hospital for Insane	1500	Sewerage	1914–15	Reconstruction of existing septic tanks. Trickling filter. Final settling tank (Imhoff). Sludge beds. Outfall sewer.	$7,632	$1,603	Work done by patient (inmate) labor
		Water supply	1916–17	1-m. g. settling reservoir. Low-lift pumping station. Mechanical filter plant, capacity 0.5-m. g. d.	15,000*	1,073	
Maryland House of Correction	625	Sewerage	1917–19	Rearrangement of sewerage system. Primary settling tank (Imhoff). Trickling filter. Final settling tank (Imhoff). Chlorinator house and detention tank. Sludge beds. Outfall sewer.	22,000*	....	Total cost of improvements $86,500, including engineering. Work done by inmates.
		Water supply	1917–19	Impounding reservoir with earth dam. Coagulating basin and 1-m. g. settling reservoir. Low-lift pumping station. 0.3-m. g. d. slow sand filter plant. 0.1-m. g. elevated tank. Distribution mains.	56,000*	8,500	
Maryland Tuberculosis Sanatorium	600	Sewerage	1917	Rearrangement of sewerage system. Primary settling tank (Imhoff). Trickling filter. Final settling tank (Imhoff). Intermittent sand filters. Sludge beds. Outfall sewer.	15,335	1,956	Local labor hired for work
		Water supply	1923	Auxiliary supply. High-lift pumping station. 2½-mi. supply line to existing works.	14,500	2,500	
University of Maryland.	500	Water supply	1919	1-m. g. settling reservoir. 0.15-m. g. d. slow sand filters. High-lift pumping station.	23,325	2,163	Labor obtained from contractor.
Crownsville State Hospital for Colored Insane	600	Sewerage	1917 1919–20 1922–3	Outfall sewer. Grit chamber and grease trap. Primary settling tank (Imhoff). Trickling filter. Final settling tank (Imhoff). Intermittent sand filters. Sludge beds.	25,118	3,405	Portion of work done by inmates, remainder by contract.
Colored Tuberculosis Sanatorium	150	Sewerage	1922–23	System of collecting sewers. Settling tank (Imhoff). Sludge bed. Chlorinator house and detention tank. Outfall sewer.	6,670	....	Work done by contract
		Water supply	1922–23	Three-mile supply line from Springfield State Hospital. 0.15-m. g. standpipe. Distribution mains.	41,916	3,203	
Spring Grove State Hospital for the Insane	1200	Sewerage	1922	Complete disposal works proposed, to consist of primary settling tank, trickling filter, final settling tank and intermittent sand filters.	25,000*	....	Surveys only completed. Plans not completed as contemplated county sewerage system will provide for institution.
Maryland Training School for Boys	200	Water supply	1923	Proposed auxiliary supply. One-mile supply line. High-lift pumping station. Force main to existing distribution mains.	25,000*	....	Surveys, preliminary plans and cost estimates prepared. Funds for construction work requested in 1924.

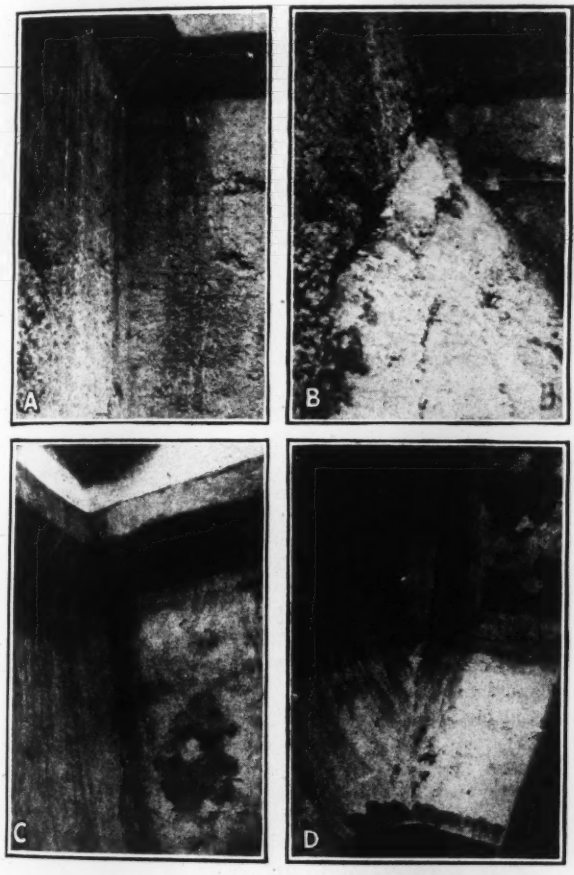
*Estimated.

TABLE II—WATER FILTRATION PLANT DESIGN DATA

Institution	Population Works Designed for	Water Consumption Gal. per Day	Water Filtration Plant: Kind	Capacity Gal. per Day	Rate of Filtration Gal. per Acre per Day	Filters: No.	Sand Depth and Characteristics: Size Ft.	Depth In.	Uniformity Coefficient	Effective Size mm.	Depth of Gravel Inches	Chlorination
Springfield State Hospital	2,500	300,000	Rapid sand	500,000	125,000,000	2	8x11	36	1.3	0.50	12	Liquid chlorine
Maryland House of Correction	1,000	190,000	Slow sand	300,000	7,000,000	2	26x36	36	1.9	0.40	10	Liquid chlorine
University of Maryland	1,000	75,000	Slow sand	150,000	5,000,000	2	20x32.5	36	1.4	0.35	12	Hypochlorite

fully the operation and maintenance of the works which have been built at considerable cost.

With this fund on hand the services of an operation and maintenance engineer could be obtained who would spend his full time supervising the operation and repair of these plants. Closer supervision on the part of the bureau is not possible with the limited personnel and appropriation. There are occasions, however, when it is necessary to delegate one of the force to take charge of operation and maintenance of an institutional plant, at the sacrifice of other duties.



INTERIOR WALLS OF PRIMARY SETTLING TANKS
Crownsville State Hospital Sewage-Works. A and B—Walls chipped and ready for waterproofing. C and D—Appearance after waterproofing had been applied.

In Tables II and III the unit data used in the design of the water and sewerage works at state institutions are given.

Some of the more unusual features of design, construction and operation of the works installed are indicated in the following paragraphs:

Springfield State Hospital for Insane—The principal source of water supply was from deep wells, whose yield was entirely inadequate. The water was extremely hard and unsuited for boiler purposes. To make up the deficiency of the well supply, raw water was pumped from Piney Run, a small stream passing through the hospital grounds, directly into the distribution system. The bureau recommended the development of Piney Run and the abandonment of the wells.

Plans for the filtration plant were prepared by outside engineers. The construction, supervised by the bureau at the request of the hospital authorities, was done by inmates with the assistance of several skilled laborers employed to perform the more important work. While this plan was responsible for delay in the completion of the plant and increased the engineering costs, considerable saving resulted in total construction costs.

Due to numerous complaints from adjoining property owners on the stream below the hospital, regarding the condition of Piney Run resulting from the discharge therein of sewage, the authorities were preparing to complete the installation of a sewage treatment plant according to plans prepared in 1907. Further treatment of the sewage, after passage through the existing septic tanks, was to be by broad irrigation and gravel filtration. The plant would cover approximately 10 acres of land bordering on the stream. The type of works proposed was unnecessarily expensive, would not produce a satisfactory effluent and utilized land more useful for other purposes. The plant as built is described in Table I. It occupies about 0.1 acre of land.

The estimated cost of finishing the treatment plant as originally planned, exclusive of engineering, was $15,710, whereas the cost of the works installed was $7,632, or less than one-half the former amount.

Maryland House of Correction—The decision to construct a slow sand filter plant instead of rapid sand, the type more frequently used in this vicinity, was made after careful consideration of the kind of attention similar installations, under the observation of the bureau, had received in the past. While the cost of the former is somewhat greater than a rapid sand plant of the same capacity, its operation with prison labor was believed to be simpler and less costly. In addition, Dorsey Run, the source of supply, is not as turbid as some of the larger streams in this section and normal turbidities could be readily taken care of in the settling basins.

If the bureau were to design a water filtration plant for this institution at the present writing, the type of plant selected would be rapid instead of slow sand, largely due to a change in the administrative methods of these institutions, resulting in more permanent operating personnel. While the cleaning of the filter beds was believed to be an operation which could be done readily and quickly with the labor available, this actually has not been the case. The result has been that the filters are sometimes out of service for several days during the cleaning process, necessitating opening the bypass in order to furnish sufficient water.

An ultra-violet-ray sterilizing apparatus was first installed, in place of the chlorinator, to treat the filter effluent. Its use was discontinued after a trial of seven months on account of the excessive cost of lamp renewals. The choice of the ultra-violet-ray apparatus did not not anticipate the great loss in lamps which actually occurred. As the institution manufactured its own power and past experience with the operation of the chlorinator here had been most unsatisfactory on account of lack of attention, it appeared that the ultra-violet-ray apparatus would be more desirable.

It was unfortunate that the water-supply and sewerage improvements could not have been made immediately after the completion of the plans, when prices were low. Labor and material costs had advanced excessively during the intervening period, as the result of war conditions. A brief comparison of material costs only available water course into which the effluent of the plant could discharge was a small stream, practically dry at times, it was necessary to provide works which would produce as clear an effluent as possible.

This plant was placed in operation in July, 1917. About the middle of December of the same year the bureau was notified that the plant was frozen, would not function and would have to be put out of operation during the winter. Investigation showed that the scum in the gas vents of the primary tank, approximately 3 ft. thick, had frozen solid to a depth of nearly 1 ft. The sludge digestion compartment was filled with sludge. The result of this condition was the gradual accumulation of gases in the gas vents which were held in by the frozen top of the scum. As the volume of these gases increased and no outlet was available they caused the 4-in. reinforced-concrete partition walls on both sides

TABLE III—SEWAGE-TREATMENT PLANTS FOR MARYLAND

Institution	Population		Sewage Flow—Gal. per Day		Primary Settling Tank				Trickling Filter								Final Settling Tank			
									Sprinkler Nozzles				Filter Stone							
	Actual	Works Designed for	Measured	Assumed—used in Design	Type	Detention Period Hr.	Sludge Digestion Cu. Ft. per Capita	Superficial Area of Gas Vent Per cent	Size, Ft.	Rate, Gal. per Acre per Day	No.	Kind	Spacing Ft. C. to C.	Depth, Max. Ft.	Size, In.	Type	Detention Period Hr.	Sludge Digestion Cu. Ft. per Capita	Superficial Area of Gas Vents Per cent
Springfield State Hospital	1,500	2,000	187,000(a)	240,000		Old tanks remodelled			75.25x87.25	2,000,000	30	Taylor Square Spray	12	7	1—2½	Imhoff	1½ (b)	0.18	8.0
Maryland House of Correction	625	1,000	180,000	200,000	Imhoff	2 (c)	0.70	6.2	68.25x80.25	2,000,000	30	Taylor Square Spray	12	6.75	1—2½	Imhoff	1½ (c)	0.37	5.7
Maryland Tuberculosis Sanatorium	600	1,000	60,000	100,000	Imhoff	2 (c)	1.00	14.0	45x57	2,500,000	12	Taylor Square Spray	12	6	1—2½	Imhoff	1½ (c)	0.54	14.0
Crownsville State Hospital	600	1,000	92,000	150,000	Imhoff	1½ (b)	1.75	9.0	58x63	2,500,000	16	Taylor Square Spray	12	5.5	1—2½	Imhoff	1 (b)	0.875	9.3
Colored Tuberculosis Sanatorium	(f)	150		30,000	Imhoff	1 (b)	2.5	25.0	.....	.....		.....	..	....	.....	..	..	....	.....	...

(a)—187,000 in Feb., 1915—238,500 in Aug., 1915.
(b)—Based on assumed sewage flow.
(c)—Based on assumed sewage flow occurring in 18 hours.
(d)—Large sludge bed for remodelled tanks while two small ones are for final Imhoff tank.

(Table IV) will give some indication of the saving that might have resulted if the work had been done in 1914-15, as recommended by the bureau.

A quotation of $3,750 was obtained for an elevated tank in 1915, whereas a tank of the same capacity, with a slightly higher tower, cost $7,685 in 1917.

Maryland Tuberculosis Sanatorium—The sewage-works at this institution consisted of a small septic tank and a subsurface irrigation field of considerable size on the mountain side. In 1915 serious operating difficulty was experienced, due to the saturated condition of the irrigation field, rendering it incapable of caring for the flow. The sewage pooled on the surface of the ground over the lines of distribution tiling and created offensive conditions. Sewage had found its way into a deep cut of the Western Maryland R.R. and threatened serious damage to the roadbed.

The authorities were aware of the immediate need of correcting these conditions but sufficient funds were not available for necessary improvements. No allowance for this work was made at the subsequent legislative session, so the State Board of Health was requested to order the construction of sewage-works. As conditions in and about the existing works were deplorable, from a health standpoint, and as this appeared to be the only way to get the plant built during the next few years, an order to this effect was issued.

Plans were prepared by the bureau and the construction work was carried on under its supervision. As the of the tank, between the gas vents and sedimentation chamber, to bulge. Fortunately this condition was discovered in time to prevent serious damage to the structure. To guard against a recurrence of this condition wooden covers were placed over the gas vents during the winter months to prevent freezing and the thin dividing walls were braced. No trouble has since been experienced.

Three of the sand filters in service were covered with a 3- to 6-in. sheet of ice and the sand in the beds was frozen. The fourth bed, held in reserve, had about 6 in. of snow on it and the sand was frozen to a depth of approximately 2 in. Proper operation of these units during the extremely cold weather, common in this section during the winter, was out of the question. It was recommended that the sand beds be bypassed during cold weather until the early spring. This plan has been followed with much satisfaction. As the stream receiving the final effluent has considerable winter flow, no objectionable conditions have been noted.

The concrete at the water line in the settling tanks and dosing tanks had been spalling off to such an extent that the reinforcing steel was exposed in one instance. This condition had been observed for several years and during the summer of 1923 these bad places were patched up. This was accomplished by drawing down the water levels in the tanks to allow for the erection of scaffolds. The old concrete was chipped out at the places where it had disintegrated, for a

distance of about 1 ft. above and below the water level. The holes were filled with a 1:2 cement mortar in which "Konax" was mixed in the proportion of 1 quart of this material to a bag of cement. The surfaces were trowelled to a smooth finish and after setting were given two coats of Hard-N-Tyte with a 24-hr. interval between coats. This work was done in July. At the end of the year the repaired structures appeared to be in good condition and the patches showed no cracks.

The water-supply situation at this place is similar to that of many other state institutions dependent upon underground sources. Ample supply is available during only eight or nine months of the year. At present water is obtained mainly from a series of springs located about a half mile southwest of the institution, from which water flows by gravity to two collecting reservoirs at the pumping station and from here it

STATE INSTITUTIONS, DESIGN DATA AND SPECIFICATIONS

	Sludge Beds							Intermittent Sand Filters								Disinfection		
			Sand			Gravel					Sand			Gravel				
Institution	No.	Size, Ft.	Area, Sq.Ft. per Capita	Depth, In.	Effective Size, Mm.	Uniformity Coefficient	Depth, In.	Size, In.	No.	Size, Ft.	Rate, Gal. per Acre per Day	Depth, In.	Effective Size, Mm.	Uniformity Coefficient	Depth, In.	Size, In.	Chemical	Detention Period (Minutes)	Dose (p.p.m.)
Springfield State Hospital	3(d)	1—54x65 2—10x15	1.75 0.15	30 3	(e) 0.23	.. 2.3	6 9	½—1½ 1—1½	...	.....	.....	.....	.....	.....	...	.....	.....	.....	....
Maryland House of Correction	3	13.25x18	0.75	6	0.36	1.55	6	½—1½	...	.....	.....	....	...	...	...	.....	Liquid Chlorine	5	8.0
Maryland Tuberculosis Sanatorium	2	16x16	0.51	3	(e)	..	9	1—1½	4	26x42	1,000,000	24	0.39	1.65	4	½—1½	.....	.....	....
Crownsville State Hospital	3	13x18	0.71	6	0.35	2.4	6	½—1½	4	36x75	600,000	24	0.35	2.4	4	½—1½	.....	.....	....
Colored Tuberculosis Sanatorium	1	12x12	0.96	6	0.18	2.7	6	½-1½	...	.....	.....	....	....	....	...	.....	Liquid Chlorine	30 (g)	10.00

(e)—2 in. of coarse concrete sand, 1 in. of mortar sand.
(f)—Sanatorium opened in September, 1923—not yet filled to capacity.
(g)—On assumed future daily sewage flow of 60,000 gallons.

is pumped, after chlorination, to a distributing reservoir located on the mountainside above the buildings.

The water situation became so acute during the fall of 1922 that at one time it was thought the institution would be forced to close on account of lack of water. To eliminate trouble from this source in the future, the bureau was asked to take charge of the installation of an auxiliary water supply. A small stream near Deerfield, about three miles southwest of the hospital, under observation for several years, appeared to be the most desirable supply in this section. Its flow is fairly large, it is not a flashy stream and drains a sparsely inhabited watershed.

As there was no special appropriation available for this work, funds to carry it on had to be taken out of moneys which the institution had earned. For this reason it was necessary to keep the cost of the improvements at a minimum. A small intake dam of loose-laid stone was built in the stream. A wooden pump house with motor-driven triplex pump was installed to force the water through about 8,600 ft. of 4-in. cast-iron pipe to a manhole located at the high point in the line and 145 ft. above the intake. From the manhole the water flows by gravity through 4-in. cast-iron pipe, 4,000 ft. in length, to the existing collecting reservoirs.

The bureau recommended the use of 6- instead of 4-in. pipe to cut down the pumping charges and to provide a supply main of ample capacity to take care of future growth of the institution. In view of the fact that it was not possible to get increased funds for the larger main, and as there is little probability of the future population increasing materially, the smaller main was permitted in this instance.

McWane precalked-joint cast-iron pipe was used in the line from the pump house to the manhole at the high point. The remainder was laid of pipe originally intended to have this special joint, but which was slightly crooked and therefore was not equipped with it. The joints in the gravity portion of the line were made with leadite. A saving of approximately $1,700 was made by purchasing the precalked-joint pipe instead of Class A, 4-in. cast-iron pipe, which was quoted at $82.40 per ton delivered. A slightly lower quotation than this was obtained for delivery in November, but as the work could not be postponed that long, this quotation was not considered. The precalked-joint pipe was bought for 76.5c. per foot delivered and the crooked pipe cost 62c. per foot.

University of Maryland—The principal source of water supply had been for a number of years Paint Branch, a small nearby stream with a watershed area above the intake of 30.5 sq.mi. Water was pumped from the stream without treatment to an elevated storage tank located on college property and adjacent to the buildings, about a mile southwest of the intake. From this tank water was conveyed to the various buildings by the distributing mains. The quality of the water was poor and a hypochlorite-of-lime treatment plant was installed in the pump house in 1916. On account of the many sources of pollution on the watershed and the inadequate attention given to the treatment plant, it was impossible to obtain a consistently safe water. Several attempts were made to improve conditions but without satisfactory results. In September, 1918, the bureau was requested to prepare plans and supervise the construction work of a water filtration plant for the university, due to the fact that a unit of the students army training corps was to be stationed there.

The water filtration plant as built is of a temporary nature, due to the fact that the university is within the Washington Suburban Sanitary District, and, therefore, adequate water-supply service will eventually be provided from the district supply.

During 1920 certain minor repairs to some of the structures and the pipe lines were necessary on account of leaks which had developed in them. To keep the construction costs at a minimum, and due to difficulty in obtaining cast-iron pipe, the connection between the various units of the filtration plant was made of terra-cotta pipe encased in concrete and lines under pressure were of wood-stave pipe. The majority of the leaks were found in the terra-cotta pipe lines laid in concrete. It was necessary to relay these lines. Several sections of wood-stave pipe had to be cut out and replaced by cast-iron pipe. Cracks in the concrete lining of the clear water basin were successfully repaired with lead wool.

Crownsville State Hospital for Colored Insane—In 1915 all sewage from the buildings was discharged into a small ditch about 500 ft. south of the buildings, eventually finding its way in a raw state into a small water course. The bureau recommended the construction of complete sewage-works, as the stream which was to receive the final effluent is small. No funds for these improvements were on hand at the time. Four years later construction work was started on the primary settling tank. The work was done by inmate labor directed by a foreman, under the supervision of an engineer of the bureau. The inmate labor was unsatisfactory and entirely unfitted for this work, which necessitated the hiring of additional outside labor to complete the tank. Nothing further was done on the construction of the sewage-works until 1922, when the remainder of the works was completed by contract.

As soon as minor adjustments of the treatment plant were made it was placed in operation. Serious leaks developed in the primary tank and it was necessary to take immediate steps to repair them. Various means were adopted, but none proved successful. Finally a proposal was made by the proprietors of Hard-N-Tyte to resurface the inside of the tank from the gas vent down to and including the hopper bottom, and to give a surety bond guaranteeing the watertightness of this portion of the structure for a period of three years. When the concrete surfaces were chipped, preparatory to applying the waterproofing coats, the concrete was found to be in extremely poor condition in spots, due, it is believed, to poor mixing by patient labor and to improper placing of the concrete in the forms. It was not always possible to have an engineer on the job while the work was progressing and the foreman in charge of the work may not have been as particular as he should have been in mixing and placing the concrete. All of this poor work was cut out before the application of the waterproofing material. Waterproofing was applied in six successive coats, bonding the first to the wall and each successive one to the preceding one, so as to make the waterproofing an integral part of the structure. When the work was finished the interior surfaces of the tank were smooth and appeared to be in excellent condition. Sewage was introduced into the works early in March, 1923, and since then no leaks have developed. The accompanying views show clearly the condition of the concrete in the interior walls of the tank after the surfaces had been chipped and the finished surfaces after the waterproofing had been applied

When the treatment plant had been in operation for several months it was noted that quantities of fine sand were collecting in the screen chamber and getting into the primary tank, and large quantities of grease were accumulating on the surface of the sewage in this tank, which materially interfered with its functioning. A combination grit chamber and grease trap, just in front of the primary settling tank, was built entirely by inmate labor, with the carpenter of the hospital in charge, under the direction of the bureau.

Colored Tuberculosis Sanatorium—In 1921 the bureau was requested to prepare contract plans and specifications for the installation of water and sewerage works for the proposed sanatorium for the colored at Henryton.

Consideration of underground sources and surface streams in the vicinity indicated that the yield from wells in the geological formation of this area was doubtful. The use of water from the various streams in this vicinity was not favorably considered, on account of the probability of their being polluted by sewage from nearby towns and of the heavy pumping charges which would be entailed. A filtration plant taking water from any of these streams would require careful operation at all times. Past experience indicated that such operation was extremely difficult to obtain at state institutions.

The most favorable solution of the water-supply problem was to take water from the Springfield State Hospital filtration plant. To do this involved the construction of a supply main of approximately three miles in length and a reservoir or low standpipe at a suitable point on the sanatorium property. The first cost of this project was estimated to be greater than any of those already outlined, but the annual operating charges and costs for the water used would be slight. The filtration plant at the hospital was of sufficient capacity to furnish the required amount of water, so that no additions were necessary to the present equipment.

TABLE IV.—COMPARATIVE COSTS OF MATERIAL 1915 AND 1917

Material	1915	1917
Cast-iron pipe, per ton	$22 00	$65 00
Cement, gross, per barrel	1 60	2 34
8-in. terra-cotta pipe, per foot	0 14	0 21
Reinforcing steel, per pound	0 025	0 05

On account of the rolling nature of the country over which the supply line was laid, some provision had to be made to prevent the accumulation of air at the high points. Six 1-in. Simplex automatic air-relief valves were placed at the major summits of the pipe line and three manually operated 1-in. Mueller air vents were installed at the minor summits. As the high-water level in the standpipe at the sanatorium is much lower than that maintained in the Springfield State Hospital standpipe, it was necessary to install a controlling altitude valve in front of the former structure to prevent the tank from overflowing. This valve is so adjusted that the standpipe is always full.

The Patapsco River, which passes through the hospital property, is used as a source of water supply for portions of Baltimore City and Baltimore County, after filtration and chlorination. It was deemed advisable to require as complete purification as possible of the sewage entering the Patapsco River. A primary settling tank, trickling filter, final settling tank and intermittent sand filters, with the final plant effluent to be chlorinated before emptying into the river, were planned for the sanatorium. As only a portion of the

hospital was to be built at this time and it was learned that the Patapsco River as a source of water supply for Baltimore and vicinity would be discontinued within a few years, only the primary settling tank was built, the effluent from which is chlorinated before discharge into the river.

Acknowledgements: The water-supply and sewerage construction work at state institutions was started while Robert B. Morse was chief engineer of the bureau. It was due to his efforts that the provisions delegating these duties to the State Department of Health were made in the law of 1914. All engineering and construction work was done under his direction from that date to the time of his resignation in June, 1922. Since this time the work has been under the control of Abel Wolman, the present chief engineer. Harry R. Hall, assistant chief engineer, was in charge of the design and construction work until his resignation in September, 1922. The writer has been engaged on this work since the beginning, first on the design of the various works and later in charge of preparation of plans and construction of the last three installations. Recognition should be given here, also, to the important contributions to this branch of activity by F. W. Caspari, H. F. Schaefer and J. R. McComas, engineers of the bureau, who have been associated with much of the design and construction work. The writer here wishes to express his appreciation to Mr. Wolman for his helpful criticism of the material in this paper and for his valuable aid in its preparation.

Typhoid, Water Supply, Carriers and the Courts

Private Companies and Municipalities Alike Held Responsible as Also Employers Under Workmen's Compensation Acts

By James A. Tobey
National Health Council, New York City

CASES relating to typhoid fever have been before the courts of last resort in this country on numerous occasions. The liability of municipalities and private water companies for typhoid fever contracted from polluted water supplies is the chief subject embodied in these court decisions, though of late there have been a number of cases dealing with typhoid fever as an accident under workmen's compensation laws. One notable recent case is concerned with the restraint of a typhoid carrier. The rules of law laid down by these cases are, in general, fairly uniform, as will appear from a brief review of some of them. The cases hold that private water companies and municipal corporations which furnish water for human use are both liable for injury due to lack of reasonable care in providing pure water; that typhoid fever contracted in the course of employment due to the negligence of the employer is an accident under most workmen's compensation laws; and that a typhoid fever carrier may be legally quarantined in the interests of the public health.

A private corporation which supplies water for human consumption is not, in the absence of a statute to the contrary, an insurer of the purity of the water, nor of its freedom from the possibility of infection. Such a company is, however, bound to use reasonable care and diligence to provide pure and wholesome water, free from contamination. If it does not do so, it is liable for injuries caused. As was remarked in a New Jersey case (*Jones v. Mount Holly Water Co.*, 1915, 87 N. J. L. 106, 96 Atl. 860) "Water is a necessity of life, and one who undertakes to trade in it and supply customers stands in no different position toward those with whom he deals than does a dealer in food stuffs. He is bound to use reasonable care that whatever is supplied for food and drink shall be ordinarily and reasonably pure and wholesome."

Private Company Liability—A few illustrations will make the extent of this liability more clear. During a period of low water a Pennsylvania water company connected its mains with a badly polluted river and was held liable for the death of a child from typhoid due to drinking this water. (*Kohlmeyer v. Ohio Valley Water Co.*, 1914, 58 Pa. Super. Ct. 63.) This same company was held not liable, however, in another case where the evidence was insufficient to show that plaintiff's intestate drank a sufficient amount of the water to cause the disease (*Gosser v. Ohio Valley Water Co.*, 1914, 244 Pa. 59, 90 Atl. 54, Ann Cas. 1915 C, 685). In Wisconsin a plaintiff was held guilty of contributory negligence in not himself taking the usual precautions where the existence of typhoid was widely and publicly known and had even occurred in his own family. (*Green v. Ashland Water Co.*, 1898, 101 Wis. 258, 77 N. W. 722, 43 L. R. A. 117, 70 Am. S. R. 911.) In Pennsylvania an injunction against the furnishing of unwholesome water was sustained by the court (*Peffer v. Penn. Water Co.*, 1908, 221 Pa. 578, 70 Atl. 870), but in the same state it was held that a water company was not liable for negligence for failure to ascertain that typhoid fever existed on property not controlled by the company, a mile and a half above the point where the supply was taken (*Buckingham v. Plymouth Water Co.*, 1891, 142 Pa. 221, 21 Atl. 824). Finally in a Connecticut case the court ruled that it was a question of fact for the jury to decide from the evidence whether the water company was negligent in not purifying or examining one of its sources of supply (*Hayes v. Torrington Water Co.*, 1914, 88 Conn. 609, 92 Atl. 406).

Municipalities Also Liable—The same principles applicable to private water companies hold good when a municipality is involved. The sale and distribution of water is not a governmental but a corporate or business function of the municipality. While a municipal corporation is never liable for wrongs done in a governmental capacity, such as police measures for health or safety, it may be liable for injuries done while acting within its corporate scope. Such liability for carelessness in permitting contamination of water so that typhoid was caused has been upheld in Minnesota and New York in leading cases (*Keever v. Mankato*, 1911, 113 Minn. 55, 129 N. W. 158, 33 L. R. A. N. S. 339, Ann. Cas. 1912 A, 216. *Stubbs v. City of Rochester*, 1919, 226 N. Y. 516, 124 N. E. 137). In the latter case, the court averred that the fact that the city's polluted water was the actual source of typhoid could be found from the evidence that the plaintiff drank near the point of contamination, that some 60 other cases had developed, that plaintiff's habits precluded any other source, and that his physician testified that the city water was the cause. An older New York case held that the city water was not liable for infection due to a well not used as a part of the public water supply, though

owned by the city (*Danaher v. Brooklyn*, 1890, 119 N. Y. 241, 23 N. E. 745, 7 L. R. A. 592).

Typhoid Carriers—Restriction of the liberty of a typhoid carrier was upheld as a valid exercise of the police power of a municipality by the Illinois Supreme Court only about two years ago in a remarkable decision (*Barmore v. Robertson*, 1922, 134 N. E. 815). The defendant, who was a boarding-house keeper, was quarantined as a typhoid carrier by the commissioner of health. She applied for a writ of habeas corpus to secure her release. The court, in remanding her to the custody of the health commissioner, stated that the care of the public health was the duty of the state under its police power and that authority to carry out its rules and regulations could be delegated to local ministerial officers. It was further held that a person need not actually be sick to be subject to quarantine, but if in any way dangerous by virtue of the possibility of being able to spread a communicable disease, could be isolated. The decision, a masterly symposium on public health law, is given in full in the United States *Public Health Reports* for May 26, 1922.

Workmen's Compensation Decisions—Under workmen's compensation acts, typhoid fever contracted in the course of employment has on several occasions been held to be an accident or injury within the meaning of the statutes. For instance, in a recent Michigan case (*Frankamp v. Fordney Hotel Co.*, 1923, 193 N. W. 205), it was held that where a hotel waitress contracted typhoid fever from drinking the water supplied by the hotel this was an accident and not an occupational disease. The court said that an "accident" means an unforeseen event occurring without the will of the person whose mere act causes it. (See also *Ames v. Lake Independence Water Co.*, Mich., 1924, 197 N. W. 499.) Similar decisions have been rendered in Wisconsin (*Vennen v. Dells Lumber Co.*, 1915, 161 Wis. 370, 154 N. W. 640 L. R. A. 1916 A, 273), and Indiana (*Wasmuth-Endicott v. Karst*, 1922, 133 N. E. 609. And see *Aetna Life Ins. Co. v. Portland Gas and Coke Co.*, 1916, 229 Fed. 552, 144 C. C. A. 12), but the Ohio Supreme Court has held to the contrary (*Industrial Commission v. Cross*, 1921, 136 N. E. 283). In a New York case (*Banks v. Adams*, 1917, 221 N. Y. 606, 117 N. E. 1060), a helper on a delivery wagon fell off, aggravating typhoid fever then in the incubation period, and an award to him was affirmed under the workmen's compensation act. But where an employee died from typhoid fever after an accident and there was apparently no connection between the accident and the typhoid, an instruction by the lower court to the jury that if typhoid was the direct result, such injury was the cause of death, was held by the appellate court as erroneous and misleading. (*Continental Casualty Co. v. Peltier*, 1905, 104 Va. 222, 51 S. E. 209.)

The most recent decision is one handed down by the Illinois Supreme Court and abstracted in *Engineering News-Record* Sept. 4, 1924, p. 392. An employee drank polluted water which had gotten into the drinking water supply on account of a defective valve between the industrial pipes and those used to furnish water for human consumption. The employee was ignorant of this fact and the court held that the circumstances created an accident and required an insurance company to pay indemnity for the loss of life (*Christ v. Pacific Mutual Life Insurance Co.*, 1924, p. 111).

Additional Mountain Water Supply for Flagstaff, Ariz.

Small Town and Railroad in Arid District Develop Springs from Cinder Cone—Steel Line to Replace Clay Pipe

By R. L. Baldwin
Of Burns & McDonnell Engineering Co., Consulting Engineers, Kansas City, Mo.

ENLARGEMENT of the unique water-supply system of Flagstaff, Ariz., involves extension of the existing spring-collecting system high up in a mountain valley 15 miles from the town, replacing two flow-line or non-pressure conduits of vitrified pipe with a larger single line of slip-joint asphalt-coated steel pipe and doubling the reservoir capacity. These improvements will permit the collection and storage of water during the 1½-month period it is available. Only 20 per cent of the water is used by the town, the Atchison, Topeka & Santa Fé R.R. using 45 per cent, two lumber mills 30 per cent and business 5 per cent. In addition to engine use the railroad hauls water by tank cars to the hotel at Grand Canyon.

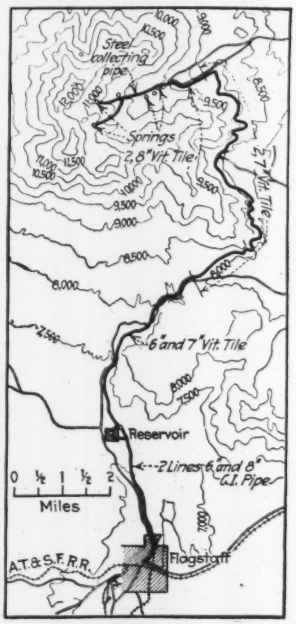


FIG. 1—WATER-SUPPLY SYSTEM FOR FLAGSTAFF

Water in the vicinity of Flagstaff, a town of 3,200 population, is scarce, although the 22-in. annual rainfall exceeds that of any other point in the state. This is due to the warm air currents striking the San Francisco Mountains, on the southern slope of which the town is located, and being deflected upward, cooled and the moisture precipitated. Greater precipitation, mostly as snow lasting in the interior valleys well through the summer, occurs in the mountains than at Flagstaff but no records are available. Ten miles north of the town are the mountain peaks which were originally parts of one volcanic cone which rose to a height of 3,000 ft. higher than the present 12,000-ft. peaks, with the cone at the west end of what is now known as the interior valley. The eastern wall of this cone was broken out, and, centuries later, the interior valley was eroded over three miles long by glacial action, leaving heavy moraine deposits which cover the floor of the valley to great depths. These deposits are largely coarse material with much disintegrated lava. The interior valley narrows at the eastern end and has a drainage area of approximately 5 sq.mi. above this narrow neck, where the elevation of the valley is about 9,000 feet.

These glacial deposits in the interior valley serve as an ideal collecting area, retaining a large part of the precipitation, which breaks out in the form of springs. The maximum flow from these springs occurs

in the month of June when the snow is melting, and drops off after the snow has melted to a minimum in the fall or after prolonged dry spells. The location of these springs gives them a natural protection against pollution. The water is low in hardness and mineral content.

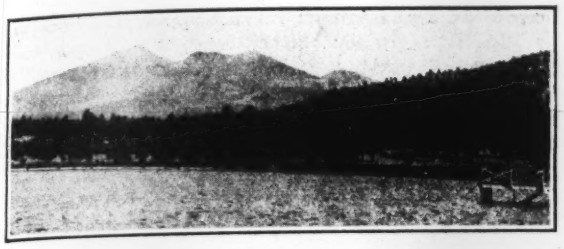


FIG. 2—50-M.G.D. RESERVOIR, FLAGSTAFF WATER-WORKS
Water-supply basin is back of the two lower San Francisco peaks in center distance.

In 1898 a pipe line was installed from the springs to a small reservoir above the town. When this became inadequate in 1914, the common interests of the town and the Santa Fé R.R. resulted in an agreement between the two whereby the railroad company financed the necessary improvements and the town agreed to operate and maintain the structures.

The water is collected from the springs by small crib-like structures set over screen boxes, and in some cases by tunnels with timber lining. Gathering lines from these spring developments converge at a point near the mouth of the valley where a weir box of concrete is installed. Collecting lines are of slip-joint, riveted, asphalt-coated steel pipe, because it is light and durable. Some of this pipe has been in service close to twenty years and is still in good condition. From the weir box at the springs to the reservoir there are now two vitrified sewer pipe gravity-flow lines, 15 miles long, one consisting of 8-, 7- and 6-in. pipe, and the other of 8- and 7-in. pipe. Concrete sumps with overflows are spaced along these lines about 4,000 ft. apart. The lines are laid partly with mortar joint and partly with asphaltic-compound joints. Neither joint prevents roots from growing into the pipes and filling them with a fibrous mat-like growth. Each year the lines must be opened and cleared of these impediments at certain places. The first line was constructed to grade varying from 2 to 4 per cent and the second line, constructed in 1914, closely parallels the first line.

FIG. 3—ROOTS TAKEN FROM VITRIFIED TILE PIPE
Neither mortar-filled nor asphaltic-compound joints prevent roots from entering pipe.

The first reservoir was of 2.5-m.g. capacity. In 1914 a reservoir of 50-m.g. capacity was put into service. The sloping sides and bottom of the larger reservoir were lined with two layers of concrete with waterproofing membrane between them. The storage is not sufficient to provide all the water desired through the long dry spells. Storage basins alone will not remedy the situation, as there must be enough pipe-line capacity to fill the basins quickly during the spring flow. An average is needed of 1 m.g.d. when the use is not curtailed. The future requirements, it is expected, will increase at the rate of 2 per cent per year. A shortage of water requires curtailment of use by all parties, but more particularly by the lumber mills and the railroad. This involves a loss of revenue and interferes seriously with the operation of local industries. Common interest is again bringing the town and the railroad together to work out a scheme to finance the needed improvements.

It is proposed to improve the collecting system at the springs and to lay a new supply main of 14- and 13-in. asphalt-coated, slip-joint, riveted-steel pipe. With such a line, storage of 150 m.g. could be accumulated in 45 days and the trouble with root growths through joints into the pipe eliminated. A large part of the material for the former work had to be carried in to the pipe line by pack mules, and it was necessary to limit the size and weight of pieces to make this feasible. Estimates of cost of the proposed work therefore include a road paralleling the pipe line as nearly as possible, which will facilitate construction and make the line easier to patrol after installation. Increased storage will be provided by an additional 50-m.g. reservoir of construction similar to that of the one now in use; a new pressure line will be provided from the reservoir to the town and the distribution system reinforced.

FIG. 4—COLLECTING WORKS AT ONE OF THE SPRINGS
Logs on crib to protect screens from rolling boulders brought down in floods due to melting snow.

The construction of the 1914 work was under the direction of the Santa Fé R.R. engineering department. Burns & McDonnell Engineering Co., consulting engineers, Kansas City, Mo., have recently reported on the necessary improvements and were retained to design and supervise the construction of the new work, which it is expected will be carried out during 1925.

Building the Nebraska University Concrete Stadium

Plant Layout and Form Design and Construction for Reinforced Concrete Grandstands with Cantilever Balconies

ECONOMICAL layout of construction plant and economical design of forms for reuse marked the erection of the War Memorial stadium for the University of Nebraska, at Lincoln, Neb., the first sections of which were completed last year. The design was such as to facilitate these economies. So many similar structures are being planned or built that the details of this one are described here for reference.

Two grandstands of reinforced concrete, with cantilever balconies, constitute the structural features of the stadium. Each of these duplicate structures is

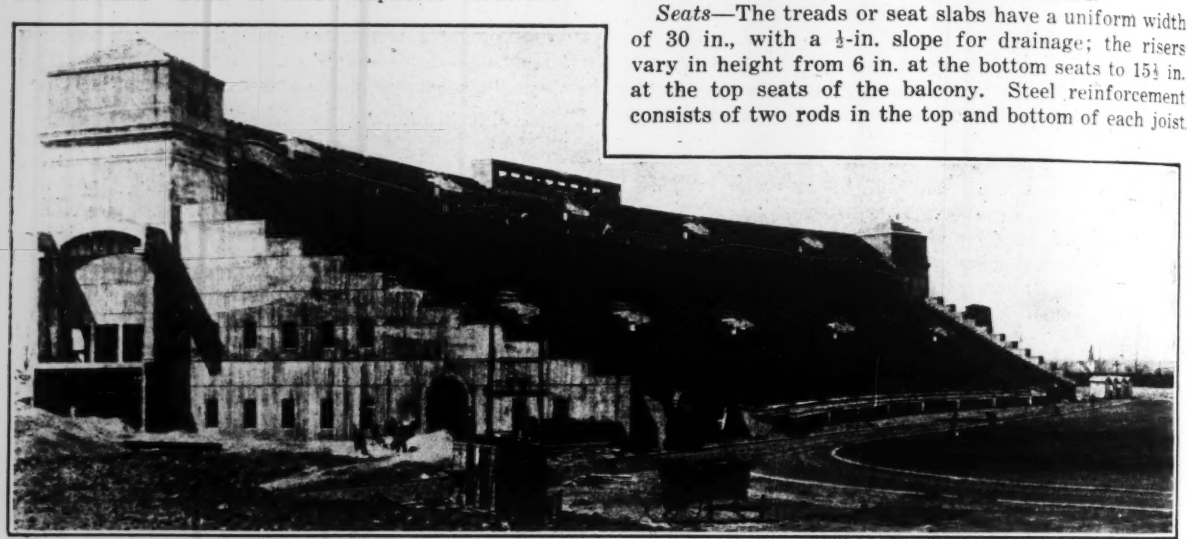


FIG. 1—ONE OF THE TWO HALVES OF THE REINFORCED-CONCRETE GRANDSTAND AT UNIVERSITY OF NEBRASKA. The other stand is similar to this and symmetrically disposed across the center line of the playing field.

135x476 ft., with a total height of 74 ft. and with sixty-seven tiers of seats accommodating 14,500 persons, or 29,000 persons in all. Additional structures may be built later to close one or both ends of the field. In Fig. 1 is shown one of the stands practically completed; Fig. 2 is a typical cross-section. The space under the west stand is utilized to house the University stores and maintenance departments.

In plan, the playing field is an oval and each grandstand is curved to a radius of 457 ft. for the front wall of the field and 553 ft. for the front of the balcony. The purpose of this rather unusual arrangement is to give the spectator not only an unobstructed view of any part of the playing field but also of the front of the grandstand in which he sits. Space for indoor athletics is provided under the rear of each stand, while bath and locker rooms and other conveniences are arranged in the end towers. Large doorways open upon the concourse, from which ramps lead to the seats. The athletic field, 244 ft. wide between the stands, includes a regulation football field, with 12-ft. safety zone for the players, and also a ¼-mile running track 21 ft. wide, one side of this being extended to form a 660-ft. straightway track.

Columns spaced 20 ft. c. to c. longitudinally carry the inclined transverse girders which support the seat joists and treads. Expansion joints, provided at intervals of 80 ft. in both the main structure and the balcony, are arranged midway between the columns, the joists having a cantilever length of 10 ft. at these joints. This arrangement was adopted in order to avoid double or split columns, which would complicate the formwork and hamper its removal. For the balcony the girders are about 38 ft. long, with a cantilever projection of 14 ft. 3 in. Steel columns are used to support these girders, on account of the slight obstruction to view as compared with larger concrete columns of the same strength.

To provide for exceptional loads due to moving crowds the entire floor area is designed for a live-load of 80 lb. per square foot, with 25 per cent additional for impact. A horizontal wind load of 20 lb. per square foot of vertical exposed area is also included.

Seats—The treads or seat slabs have a uniform width of 30 in., with a ½-in. slope for drainage; the risers vary in height from 6 in. at the bottom seats to 15½ in. at the top seats of the balcony. Steel reinforcement consists of two rods in the top and bottom of each joist or riser and a sheet of No. 12 wire mesh extending through treads and risers. Cypress blocks to support the seats are anchored to the concrete by 1-in. bolts, and each block rests on the heads of four bolts screwed into its base, in order to allow free drainage. This construction is shown in Fig. 4. To secure uniform height of seats, the blocks are 4 to 8 in. high, according to the height of riser. Three lines of 2x3½-in. sticks with chamfered edges form the seats and are secured to the cypress blocks by No. 12 screws. All the blocks and seat strips were dipped in cold creosote before being placed.

Galvanized pipe railings to guard the passages and form partitions for the boxes were made and fitted on the job, so as to secure good alignment. Metal sleeves were placed in the concrete as it was poured, the posts being then placed in the holes and adjusted to line before the setting of the concrete.

Construction Layout—Two duplicate concreting plants were arranged, as shown in Fig. 5, and as the site is adjacent to railroad yards a track plan was laid out so that materials could be unloaded directly from cars into the storage bins above the mixing plants. From the spur track that enters the University grounds a track 60 ft. from the outer walls was laid around the

val; cars ordered from the yard were set on the spur in less than twenty-four hours. The distance to the cement mills was 90 miles, and to the sand pits 38 miles. Stationary stiff-leg derricks unloaded the sand and placed the material in the storage bins.

Each of the two plants included a stationary stiff-leg derrick, stationary hoist, tower, sand and gravel storage bins, cement shed and a sawmill. Industrial cars on tracks laid in either direction from the tower carried concrete from the storage hopper to any part of the structure. The work was handled by a superintendent in charge, assistant superintendent, engineer, two carpenter foremen, a steel foreman, two labor foremen and a timekeeper. The concrete, steel and labor gangs worked from one stand to the other alternately,

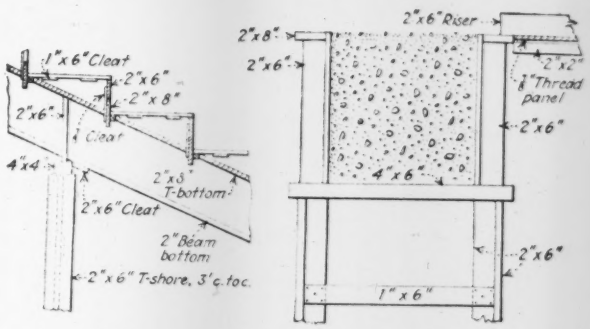


FIG. 3—FORM DETAILS OF GRANDSTAND

but as the formwork was the greatest task it was necessary to have a carpenter gang for each stand.

Wood and Steel Formwork—The biggest problem to the contractor was the formwork, since it was not only the largest item of cost but was also the determining factor in speed of construction. Each structure consists of five typical sections and two end sections, separated by the expansion joints. Forms were built for three sections of each stand for the lower tier of seats only, as the balcony tier was in part a duplicate of the lower tier. To minimize the handling of lumber, the lower tier was completed before work on the balcony was started. Approximately 760,000 ft. b.m. of form lumber were used, of which 525,000 ft. were for the initial forms, the balance being used to replace shrinkage in reuse. The total amount of lumber handled was 2,323,000 ft., giving a reuse of 4½ times with a shrinkage of 10 per cent for each reuse. Salvage will not exceed 200,000 ft. of marketable lumber.

It was found economical to use 2-in. lumber wherever possible, as shrinkage in reuse was less than with 1-in. lumber. The heavier forms gave better alignment and easier bracing, while a greater yardage of concrete could be poured at one continuous pouring.

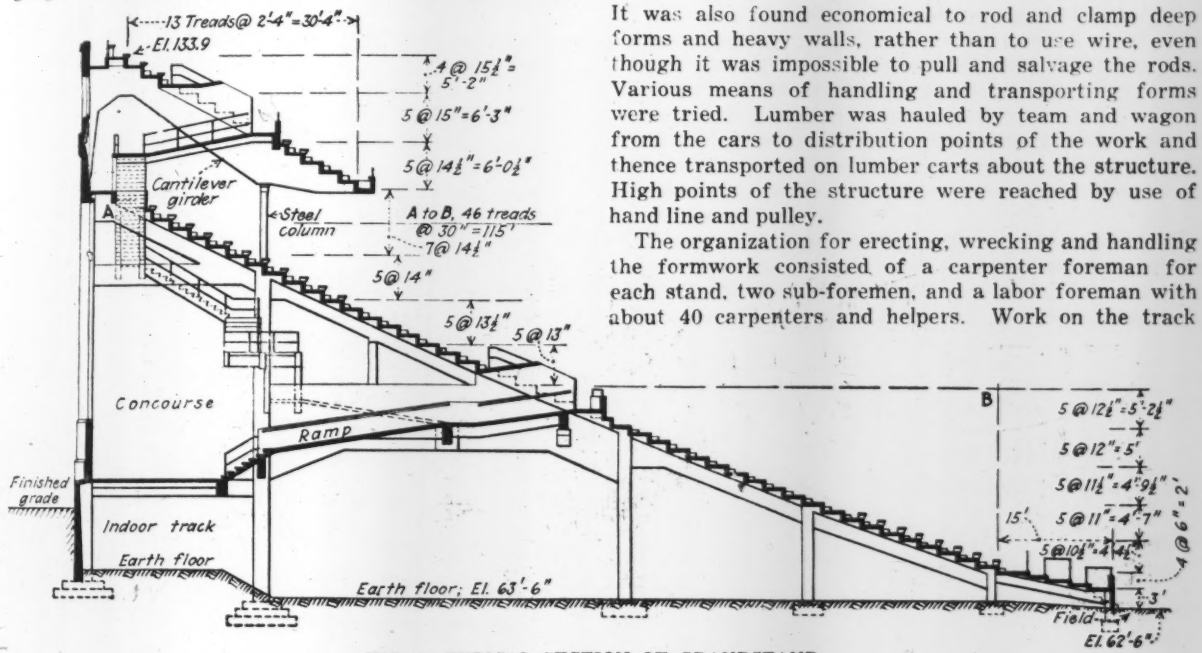


FIG. 2—TYPICAL SECTION OF GRANDSTAND

It was also found economical to rod and clamp deep forms and heavy walls, rather than to use wire, even though it was impossible to pull and salvage the rods. Various means of handling and transporting forms were tried. Lumber was hauled by team and wagon from the cars to distribution points of the work and thence transported on lumber carts about the structure. High points of the structure were reached by use of hand line and pulley.

The organization for erecting, wrecking and handling the formwork consisted of a carpenter foreman for each stand, two sub-foremen, and a labor foreman with about 40 carpenters and helpers. Work on the track tier of treads and risers and the exterior walls and concourse floor in each section was carried on by subforemen at the same time, effecting a meeting at the junction of the two. The labor foreman had charge of the handling of the forms, lumber and wrecking. This last was a very important item and a great amount of time was given to the design of forms that could be

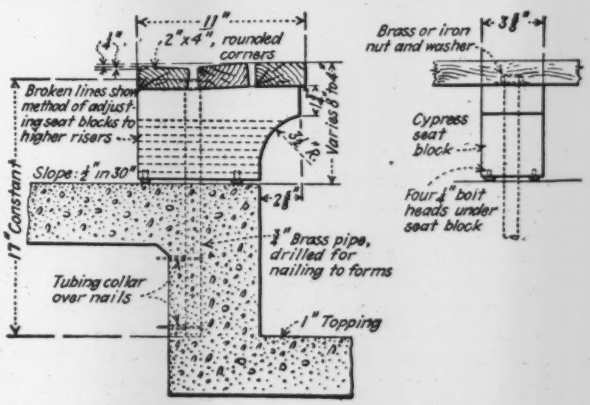

11"
2"x4", rounded corners
Brass or iron nut and washer
Broken lines show method of adjusting seat blocks to higher risers
Varies 8" to 4"
Cypress seat block
Slope: ¼" in 30"
2½"
17" Constant
¾" Brass pipe, drilled for nailing to forms
Four ¼" bolt heads under seat block
Tubing collar over nails
1" Topping

FIG. 4—DETAILS OF DECK AND SEATS

released easily. All forms were stamped with designating numbers when built, and as soon as they were released they were rebuilt and moved to their approximate positions in the next section. Great diligence was required to secure orderly wrecking and transferring of forms in order to get the maximum benefit of reuse.

Formwork was designed for framing on the ground and at the saw, and then raising to place without any adjusting as to elevations or lines by the workmen. This plan was carried out by supporting the treads and the risers from the shoring which supported the girders, and using a joist strong enough to carry the weight of the concrete, as a form for the back of each riser. The form framing is shown in Figs. 3 and 6. Girders were shored and lined by a small number of select workmen working ahead of the main gang.

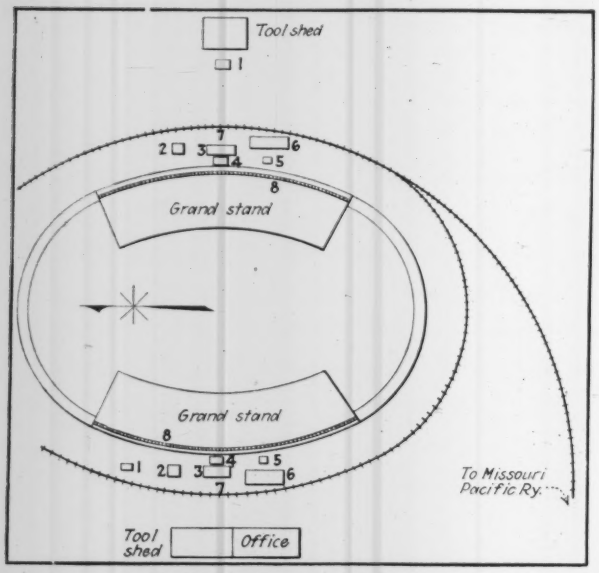


FIG. 5—PLANT USED TO BUILD NEBRASKA STADIUM
1, saw; 2, stiff-leg derrick; 3, concrete mixing plant; 4, tower; 5, tower hoist; 6, cement storage shed; 7, sand and gravel storage; 8, industrial track.

In this way a large clean-up gang completed the section and rapid work resulted. The risers and tread panels were started at the bottom, which was advantageous as scaffolding was not needed.

Although the stands were laid out on a curve, no allowance for this was made in erecting the forms, as the offset on a 20-ft. chord was less than $\frac{3}{4}$ in. The only exception was in the face of the risers, which were built of $\frac{7}{8}$-in. material. Here the curvature was acquired by sight lining between points over the girders. These forms were held in place by metal chairs on the floor, spreaders and wires at the bottom of the joists, and 1x4-in. liners at the top edges. These liners also served for holding a $\frac{3}{4}$-in. bolt by which the seat blocks were later secured and from which were hung the reinforcing bars in the top of the joist.

Steel pan forms were used only for the joists and slabs of the concourse floor of each stand (see Fig. 2). These forms were purchased in sufficient quantity for approximately 2,000 sq.ft. of floor surface; by removing them every seven days this equipment took care of the entire 16,000 sq.ft. in the concourse level. The forms were in such good shape when this work was completed that the contractor expected to use them again several times. It was estimated that they effected a saving of about 30 per cent over wood forms.

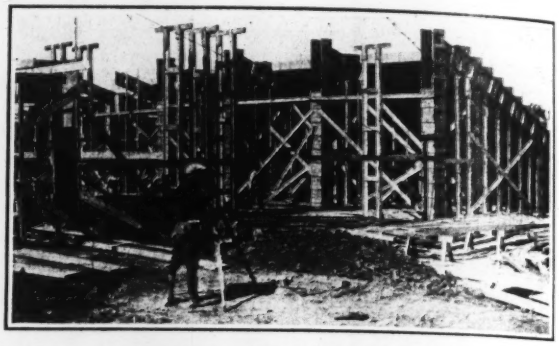


FIG. 6—FORMWORK FOR CONCRETE GRANDSTAND IN PLACE

Concrete—A sand-gravel aggregate was used, in proportions of 1 part cement to 4 parts aggregate, measured by volume. From the mixing plant the concrete was hoisted to the supply hopper at a convenient point on the tower, from which it was carried to either end in cars on industrial tracks parallel to the structure. The cars were dumped and the concrete carried through chutes to the area under construction. For the outside, the concrete was carried in the industrial cars and poured directly through zig-zag chutes into the forms in six lifts averaging about 15 ft. each.

It was necessary to pour the full 80-ft. length of each section between expansion joints, the height being determined at the central points of the beams. Each 80-ft. section was supported by columns, beams and three heavy girders with two 10-ft. cantilever ends. As the concrete came out of the chutes men leveled and spaded it in the forms. Finishers then followed to straighten the seat blocks and finish the surface of the treads. While the concrete gang was working on one stand, formwork was being built on the other stand, so that each gang could work from one side to the other. All floors and treads were rough float finished; the surfaces in contact with the forms were also left rough, without surface treatment or finishing.

Design and Construction—This stadium for the University of Nebraska was designed by Davis & Wilson, Lincoln, Neb., and John Latenser & Sons, Omaha, Neb., as associated architects, and Meyer & Jolly, Omaha, as consulting structural engineers. Its cost complete will be nearly $600,000. The contract for all work except the grading was let in May, 1923, to the Parsons Construction Co., Omaha, Neb.; Earl Hawkins, vice-president, was in direct charge of construction, with Kenneth Hawkins as assistant superintendent. There were about 16,000 cu.yd. of concrete, 785 tons of reinforcing steel and 2,323,000 ft. b.m. of formwork. The stands were ready for the Thanksgiving Day game and the contract was completed just before Christmas, 1923.

250-Ton Floating Crane Built for Japan

A floating crane larger than any previously built was recently furnished to Japan by the British firm of Cowans, Sheldon & Co., of Carlisle, according to *The Engineer* of April 11. The crane is of the luffing-boom type similar to the cranes built for the Panama Canal. It can handle its full capacity at 100-ft. radius, over end, and 300 tons at 121-ft. radius.

Corn Products Water Supply and Underground Pumps

Deep Wells in Which Water-Level Fell Connected by Tunnels to Pump Chamber—Location of Wells Accomplished by Drilling Headings and Using Exploratory Drill Pipes

RECESSION of ground water levels in the Chicago district has progressed to such an extent that for the 3.5-m.g.d. well supply required at the Corn Products Refining Co., at Argo, an underground pumping station 357 ft. below the surface has been built and connected by pipe lines in tunnels to a system of ten wells, 1,200 to 1,500 ft. deep, formerly pumped by air

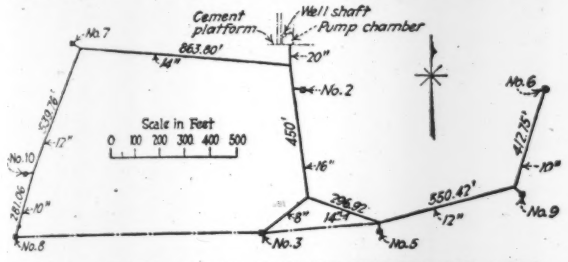


FIG. 1—UNDERGROUND TUNNEL SYSTEM FOR ARGO WATER SUPPLY

lift from the surface to a storage reservoir. Sinking the shaft through water-bearing seams, driving the tunnels through falling shale, locating the wells and connecting them to the tunnel system under heads of 150 ft. and more were some of the difficulties encountered.

No other source of supply is available since water from the city mains of Chicago cannot be had and the cost of easements and pipe line over the 12 miles to Lake Michigan is prohibitive. In 1908, when the pumping began at Argo, ground water stood at 90 ft. below the surface. Now it has fallen so much that the air lifts are insufficient, the cost high and quantity diminished. The new layout (Fig. 1) consists of a concrete-lined shaft of 10 ft. diameter to a pump chamber 35 x 30 ft. in plan and 8 ft. high connected to the ten wells by 2,800 ft. of 4 x 6-ft. tunnels lined with gunite. Two-stage hydrocone electrically-driven centrifugal pumps, having a capacity of 3,500 gal. per minute against a head of 400 ft., discharge into the existing reservoir at the ground surface. A passenger elevator with a capacity of 500 lb. and a speed of 125 ft. per minute has been installed. Both contractor's engineers and the Greeley, Howard & Norlin Co., surveyors of Chicago, made the surface survey of the well locations and dropped a 10-ft. base line down the shaft. All but two wells were found within the limits of the headings, 8-ft. wide, the two having drifted in drilling, it was learned later.

Drilling the Shaft—In sinking the shaft a vertical water-bearing seam in the rock, 4 to 24 in. wide, ending in a horizontal 3-in. seam of clay, was encountered. The shaft was carried 30 ft. below the clay seam, the clay dug out 6 in. all around the shaft and filled with 2 x 4-in. timbering. An oakum gasket was placed under the ring and the ring wedged and calked tight. Two 2-in. pipes were passed through the ring opposite each other. The vertical seams were closed by 1-in. boards, wedged in, and the concrete lining was placed to the bottom of the excavation. When the concrete had set, the drain pipes were used to force grout to fill both seams.

Two horizontal water-bearing seams were penetrated by the drills. Into six inclined holes 10 ft. deep, drilled around the circumference of the shaft, were grouted 2-in. pipes with the lower ends slightly belled and the upper ends carrying a plug cock. After 24 hours grout was forced against the water pressure of 38 lb. through the pipes in order to seal the water-bearing seam.

To get clearance under the concrete lining so that drilling could be resumed 2 to 3 ft. of gravel was placed in the bottom of the forms. When the forms were removed the gravel fell out. Twenty to thirty holes drilled with jackhammers were used per round, the number and arrangement of holes and powder used varying with the character of the rock. (See Fig. 2 for typical arrangement.) Generally ¾ lb. of powder per hole was used. The center hole and the first holes outside of the center were shot first, the rim holes last. The purpose of the center hole was to break up the rock, which together with the large number of holes permitted small charges to be effective in breaking the rock into small pieces.

The Pump Chamber—Construction of the pump chamber was slow because no large area of roof could be left unsupported. The shale was fairly hard, but on exposure it loosened on all horizontal surfaces. It was necessary to sound all roof surfaces several times a day and remove any loose material. Two side walls were built in drifts first. A top heading was then driven through the center on the line of reinforced-concrete columns for which pits to the bottom of the chamber were excavated. The columns were poured and I-beam girders set for the roof. The other two walls were then set in drifts. The roof was placed in tongue-and-groove sections 6 ft. wide, pouring of concrete immediately following excavation, the last section being placed from the shaft. All concrete was waterproofed with 12 lb. of a waterproofing paste per yard of concrete. Results have been satisfactory with no leakage in the pump chamber and only a little seepage in the shaft. No timbering was used and there was no water. The men wore respirators until the water drills were installed.

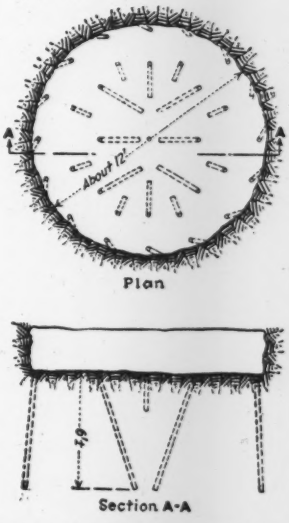


FIG. 2—TYPICAL ARRANGEMENT OF DRILL HOLES IN SINKING SHAFT

No water was found in the tunnel except near well 10 where water came through the roof at a rate of 1,200 gal. per hour. For 75 ft. this wet section was lined with heavy reinforced concrete and grout forced behind it.

The Tunnels—As in the pump chamber, the most serious difficulty in driving the tunnel was from falling

rock. While the nominal section was 5 x 7 ft., in places the roof dropped so badly that it ran up to a peak before the lining could be placed (Fig. 3). The original design, which contemplated a 6-in. reinforced lining, was changed to a 2-in. coat of gunite, after an experimental section had been put on in the usual manner and reinforced with wire mesh attached to the roof by square spikes driven into round holes. No attempt was made to get plane surfaces. To keep the lining as close to the heading as possible, the lining gang worked in one branch of the tunnel and alternated with the driving gang in the other so that the whole tunnel was driven with but a single heading in operation at one time. The average rate was 69.6 ft. per week of seventeen 8-hour shifts or 4.1 ft. per shift. The maximum speed was 6.2 ft. per shift.

Whether or not to connect with the first well as soon as the tunnel came to it was a moot question. Heavy water pressure was expected, the tunnel was in shale and much uncertainty was felt as to its ability to withstand the pressure. It was finally decided to wait until one main branch was completed so that temporary bulkheads closing off the section could be installed 200 or 300 ft. back of each well for use in case of a break-in. Each bulkhead consisted of a massive section of concrete lining, 12 to 15 ft. long, with a heavy timber door, calked and sealed, when closed, against a ½ x 6-in. flat rubber gasket nailed to the timber frame set in the lining. Three doors were built and moved from place to place but they were never needed. It was planned to plug the wells from the surface below the tunnel elevation to shut off the water in case of flooding. Two mine sinking pumps installed in the pump

FIG. 3—ROOF DROPPED BEFORE GUNITE COULD BE APPLIED

chamber in temporary timber frames removed such water as got into the tunnel.

In approaching wells the full heading was stopped 6 ft. from the point where the well was supposed to be.

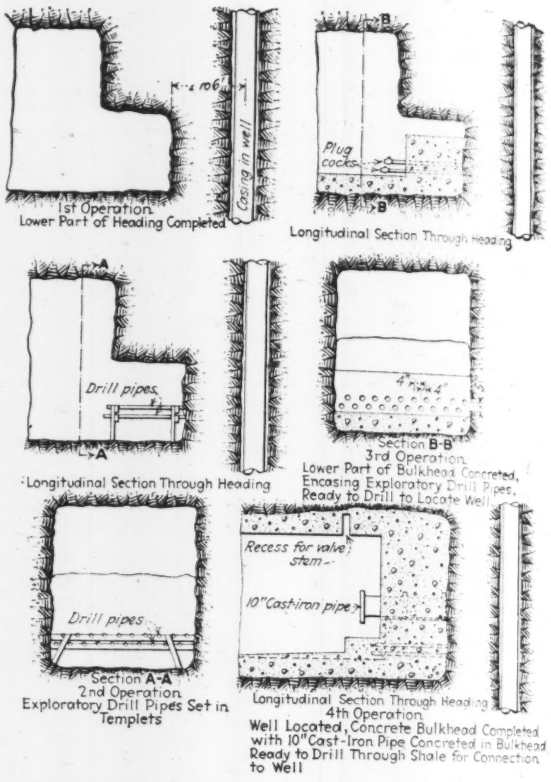

1st Operation
Lower Part of Heading Completed
Casing in well
Plug cocks
Longitudinal Section Through Heading
Drill pipes
Longitudinal Section Through Heading
Section B-B
3rd Operation
Lower Part of Bulkhead Concreted, Encasing Exploratory Drill Pipes, Ready to Drill to Locate Well
Drill pipes
Section A-A
2nd Operation
Exploratory Drill Pipes Set in Templets
Recess for valve stem
10" Cast-iron pipe
Longitudinal Section Through Heading
4th Operation
Well Located, Concrete Bulkhead Completed with 10" Cast-Iron Pipe Concreted in Bulkhead Ready to Drill Through Shale for Connection to Well

FIG. 4—OPERATIONS BEFORE CONNECTING THE WELLS

None of the schemes to locate the wells was successful. A transit needle was not deflected by the 6-in. water pipe and 3-in. air pipe. A listening device tried consisted of a metal plate 3 in. square mounted on three short metal legs and carrying an amplifier connected to head telephones. With the legs against the face it was moved across the heading while the pipe was tapped at the ground surface. The device was so sensitive that the bubbling water could also be heard but so far as locating the pipe was concerned it was no more accurate than the unaided ear.

Connecting the Wells—Operations of finding and connecting the well are shown in Fig. 4. First, the lower portion of the face was driven 3 ft. farther and then two rows of 1½-in. exploratory drill pipes were set in templets, carefully lined to parallel and then grouted, the concrete being about 3 ft. thick to form the lower part of a permanent bulkhead. The floor was also concreted for 15 ft. back of the heading. When the grout had set, each pipe across the heading was drilled until the well was located. As the wells were 12 to 15 in. and larger in diameter, sometimes as many as five drills entered the well. By noting the drill holes which just missed the well and by feeling with an iron rod it was possible to locate the center of the well with reasonable accuracy. After locating the well, points were set in the tunnel on the center line of the well, the upper part of the heading excavated to the back of the bulkhead and a short piece of 10-in. flanged cast-iron pipe set on the line of the well on top of the completed portion of the bulkhead. The remainder of the bulkhead, roof and side walls was then completed and the lower part of the bulkhead extended out to cover the ends of the plugged drill pipe.

All wells were located with the heading in this way except the two which had drifted in drilling. One had no pipe in it to tap. The exploratory drilling was spread out fan-wise to right and left of the face of the heading. Just after it was decided to lower a pipe the well was found 9½ ft. to the left and 8 in. beyond its position on the surface. It was so far out of position that a new drift was driven up to the well as there was very little water in it, all carried by a 3-in. pipe allowed to flow until a 10-in. pipe connection had been grouted into place. The second well was out of line 11 ft. to the left and 6 in. short of its position on the ground surface. No well was found in its exact position, although one was within 6 in. of it. All were to the left, indicating that the base line was probably slightly out of place but the error was small, else wells 2,000 ft. from the shaft could not have been found within an 8-ft. heading.

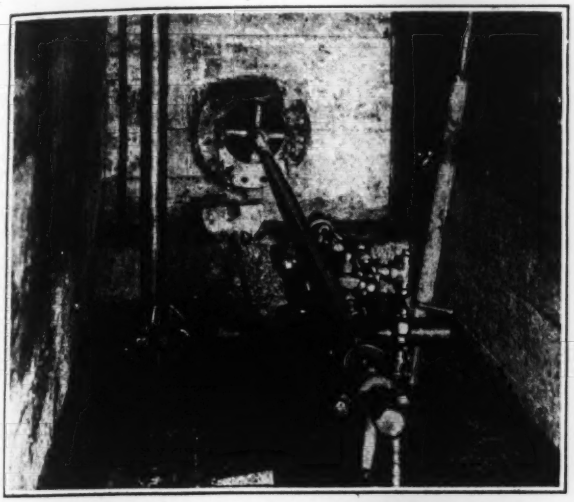


FIG. 5—DRILLING THROUGH SHALE WITH FOUR-POINT CROSS-BIT
Set up without valve for photographing. Block used under shank with rod for insertion lying on floor.

Completion of the connections involved drilling the shale and some scheme which would not permit any great amount of water to enter the tunnel. Only short shut-downs were permitted as the plant needed the water from all of the wells. The first plan was to attach a short length of pipe with a stuffing box to a gate valve on the 10-in. pipe projecting through the bulkhead, then drill through this arrangement with a 9-in. core bit mounted on a shaft passing through the stuffing box. The core barrel consisted of a 3-ft. length of 8-in. standard steel pipe mounted on a 2¾-in. shaft, 12 ft. long. The cutting tool was a sawtooth-edged cylinder somewhat similar to a calyx drill, threaded into the end of the core barrel. However, the contractor's superintendent conceived the idea of making a 9¼-in. four-point cross-bit and operating it with a jackhammer. This latter rig (Fig. 5) was used successfully. The shanks of the cross-bits were 1⅛ in. in diamater and about 15 ft. long. Regular drills with special chucks operated the drills, the speed of drilling varying up to a maximum of 4 in. per hour. There was some trouble from the bits breaking from the shanks but this was not serious. No stuffing box was used. When the drill broke through into the well it was immediately dismounted and withdrawn and the valve closed. The drill runner got a wetting but no harm was done. In wells with no casing very little water came out as the air lift took it all away. Water outside the casing in cased wells was in greater volume and the air could not take it away.

A pointed bar and small bits were used to break out a full-sized hole when the cross-bit broke through into the well. After the hole was completed an 8-in. steel liner pipe was shoved in to prevent caving in of the shale. Two set screws through the shell of the 10-in. cast-iron pipe held the liner pipe in place. The first hole was not straight as the heavy bit worked downward. A liner pipe in three sections linked together with brass links had to be used. Thereafter a notched supporting block for the shank was shoved into the hole behind the bit.

Where the well had no casing the liner pipe completed the connection. For cutting the casing the core-barrel rig (Fig. 6) was used. The air lift was first withdrawn above tunnel level. The short piece of 10-in. pipe was attached to the gate valve, the valve being closed. The core barrel with the cutting tool in place was inserted in the 10-in. pipe and the stuffing box attached to the pipe. The gate valve was then opened and the drill pushed into the hole into contact with the casing. Power for driving the tool was furnished by a small compressed air engine. After drilling on the first casing for half a day without result the core barrel and small-faced cutting tool became disengaged from the drive shaft and wedged in the hole. The barrel and tool were fished out after the tunnel was flooded to a depth of 2 ft. at the left. The wide-faced tool with the shaft was then substituted and a more

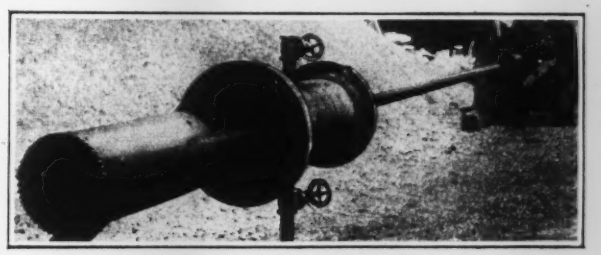


FIG. 6—CORE BARREL DRILL USED FOR CASINGS
Power furnished by compressed air engine for mixer

secure fastening of the shaft to the core barrel made. With this it took four hours to cut through the casing, when the tool landed on the center.

All plans for the construction of the shaft, pump chambers, tunnels and well connections were made by the contractor. Plans for the piping and mechanical equipment were made by the owner who purchased and installed this equipment. The contract was a cost-plus-fixed-fee job, plus also a rental charge for plant. No specifications were written except by the owner in purchasing equipment but no controversy arose during the three-year period that was not settled in conference.

The work was carried out under the general supervision of F. W. Adgate, western manager for the Foundation Co., and under the direct supervision of L. J. Hotchkiss, engineer. H. A. Meder and E. B. Stevenson were superintendents and Charles R. Walters was construction superintendent. J. J. Merrill acted for the Corn Products Refining Co. in all cases.

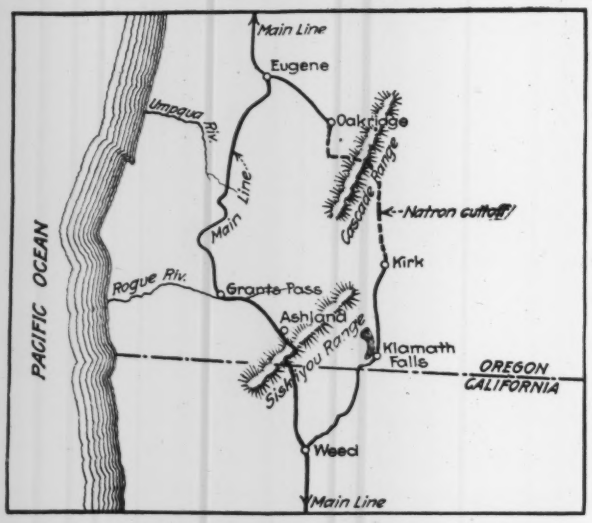
Construction Progress on the Natron Cutoff

Work on New Rail Route Connecting Oregon and California Is Being Pushed—Contract Let for Grading 32 Miles

RAIL CONNECTION between points in Oregon and California is at present limited to one single-track line which crosses the Siskiyou Mountains on the California-Oregon state boundary at El. 4,113. Due to the very heavy traffic and the difficulty of keeping this route open continuously during periods of heavy winter storms, the Southern Pacific Co. has for many years had under consideration building a second route over the mountains.

This second route, which branches off from the present main line near Eugene, Ore., crosses the mountains to the east of the present line and rejoins it again in California at Weed, is now under construction and is scheduled to be rapidly pushed through to completion. A news note about this construction program appeared in *Engineering News-Record*, Aug. 16, 1923, p. 280.

Construction along the Natron cutoff was begun at both ends in 1909 and as fast as the line was completed trains were operated to take care of such local business as offered. The 33-mile stretch between Natron and Oakridge which involved the construction of three tunnels and numerous heavy cuts, was finished in 1913. Meantime, working north from the south end, the line was completed as far north as Kirk, leaving an uncompleted 110-mile stretch between Kirk and Oakridge. South of Kirk the construction has not been heavy but to the north of this point the route lies in rough country where no local business could be expected and where construction cost will be high. When the line reached Kirk, therefore, further work on the 110-mile gap was not undertaken immediately. In recent years the fact that this was one of the extensions under control of the Central Pacific held up the work during the progress of the Central Pacific-Southern Pacific unmerger suit.



NATRON CUTOFF OF THE SOUTHERN PACIFIC RY.
Portion now under construction shown dotted

In October, 1923, the work was resumed in earnest and a construction program was laid out providing for the completion of the line as quickly as is economically possible. It was estimated that the cost would be about $15,000,000 and that construction would require about two years. The plan was to concentrate on construction at the southern end first with the idea of reaching the summit of the Cascades before winter set in, thus making it possible to establish tunnel camps north of the Divide so the heavy tunnel work could be carried on continuously, regardless of winter weather conditions. The season has been exceptionally open, however, and work has not been seriously hampered by unfavorable weather conditions along any portions of the construction work.

TYPICAL GRADING WORK NEAR KIRK, ORE.
Rail head on the new road over the Cascades

Up to the first of August progress had been made as follows: On the southern end, and, working north from Kirk, 38.5 miles of line had been graded and 38.0 miles of track laid. Working south from Oakridge, 5.4 miles of line were graded and 5.4 miles of track laid. Contracts now under way include 32 miles of roadbed of which 25.2 miles is being built by the Utah Construction Co. and 6.9 miles by Stewart & Welch Co., the latter including a 3,700-ft. tunnel under the summit of the Cascade range, some miles below the city of Oakridge.

The Natron cutoff offers advantages in grade, distance and curvature over the line known as the "main route" across the Siskiyou mountains. Via the cutoff the distance will be 24.2 miles less, the curvature will be decreased by a total of 18,452 deg., the total ascent will be reduced 2,875 ft. and the maximum grade of the old route (174 ft. per mile) will be cut down to 95 ft. per mile. Due to the direct route which the new line makes into the city of Klamath Falls, the distance between that point and Portland, the nearest large city, will be shortened by about 189 miles.

George W. Boschke is chief engineer of the Southern Pacific Co. and H. P. Hoey is assistant engineer in charge of construction on the Natron Cutoff.

Open-End Flume Water Meter Based on Exponential Equation

Universally Applicable Within Practical Limits—Equipped with Indicating, Recording and Totalizing Meter

By J. W. Ledoux
Consulting Engineer, Philadelphia, Pa.

THE HYDRAULICS of flow in open channels has been the subject of elaborate and painstaking investigation by many eminent hydraulic engineers, such as Weisbach, Bernoulli, Bazin, Chezy, Kutter and many others. Each investigator usually summarized his results in an equation in which the variable terms were the mean velocity, cross-section of the channel, slope of the water surface, and an arbitrary term called the hydraulic mean radius, which is the area divided by the wetted perimeter. There was usually introduced another variable factor representing the character of the material through which the water flowed which, when once decided upon, was thereafter a constant, so that at best there were four variables, which makes the problem one of formidable intricacy. This article shows how the number of variables is reduced to two, and a simple, indicating, recording, totalizing meter made applicable to any open flume, having its bottom and sides plane surfaces.

To determine the reliability of the flow through a channel having all the variables mentioned above, it was necessary to have some means of calibration, such as a rectangular or triangular weir, or a receptacle of known volume into which the water flowed. The

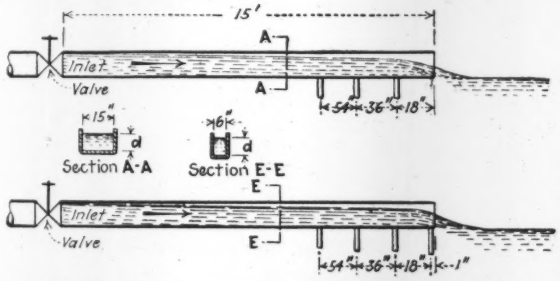


FIG. 1—OPEN-END FLUME METER OF UNIFORM CROSS-SECTION

latter device was usually impracticable for use where the volume of water was large. In recent years it has been found that reasonably satisfactory calibration can be effected by means of pitot tube measurements, a current meter or even rod floats, which necessitates dividing the channel vertically into small trapezoidal sections. If the water could be diverted into a flume of rectangular section the problem could be simplified, but heretofore it was believed that even such a device could not eliminate any one of the four variable terms, that is, the velocity, area, hydraulic mean radius and slope.

In the case of the weir, only two variables are usually necessary—volume and depth. Speculating as to whether the same elimination of variables could be effected with the rectangular channel, the writer had made under his direction a series of experiments using a rectangular channel 6 in. wide and a second channel 15 in. wide (Fig. 1). Each of these channels had a uniform section and was about 15 ft. long. The assumed formula of flow (Formula 1) was: $Q = cd^n$; in which Q = volume of flow; d = depth of water in the channel; c = constant coefficient; n = constant exponent.

Many sets of observations were taken with d measured at various points in the channel: 1, 18, 36, 54

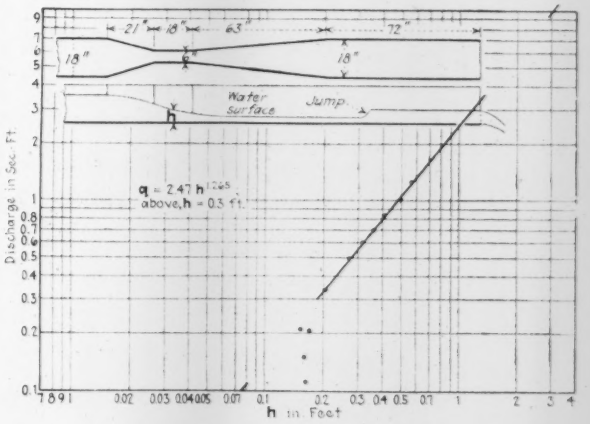


FIG. 2—VENTURI FLUME USED IN TEST

and 120 in. from the downstream end of the channel. The upstream end was supplied from a large tank the flow from which could be adjusted to any desired quantity. Over thirty measurements were made at each point in both the 6- and the 15-in. channels and the results plotted on logarithmic paper (Fig. 3). It was found that the flow at each section was proportional to the same function of d, in accordance with Formula 1 (see accompanying table).

Each one of these exponents and coefficients is the result, as before stated, of over thirty determinations, in which the minimum and maximum results were within 1 per cent of the average.

To determine whether this method is applicable to a channel of variable cross-section, an open flume with a Venturi section (Fig. 2) was substituted for one of the channels already described. The sides in all cases were vertical and the bottom horizontal, so that the section of water at any depth was rectangular. Taking the same formula and measuring the depth at the center of the throat, the coefficient c became 2.36 and the exponent n 1.2, and all of the thirty or more determinations at each point agreed with these constants, proving the formula to be strictly applicable.

It is obvious that during the observations the condition of the channel downstream from the point where

VALUES OF c AND n AT VARIOUS MEASURING POINTS FOR d

Channel Width, In.		Distances from downstream end of flume: 1 In.	18 In.	36 In.	54 In.	120 In.
6	n =	2.28	1.732	1.672	1.633	
6	c =	24.4	3.43	2.82	2.52	
15	n =		1.76	1.76	1.76	1.77
15	c =		8.4	7.2	6.6	5.25

the depths are measured should remain constant, but that any change of conditions upstream from that point will not affect the results obtained.

To make a measuring device of such a channel, it is only necessary to determine the flow for two depths, from which the coefficient and exponent can be calcu-

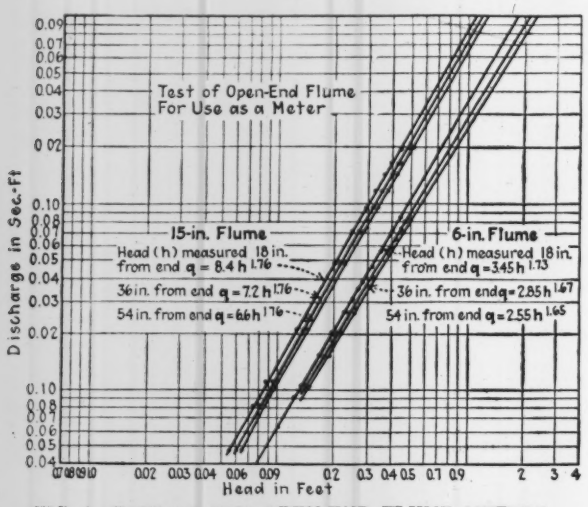

Test of Open-End Flume
For Use as a Meter
15-in. Flume
Head (h) measured 18 in. from end q = 8.4 h 1.76
36 in. from end q = 7.2 h 1.76
54 in. from end q = 6.6 h 1.76
6-in. Flume
Head (h) measured 18 in. from end q = 3.45 h 1.73
36 in. from end q = 2.85 h 1.67
54 in. from end q = 2.55 h 1.65
Discharge in Sec.-Ft
Head in Feet

FIG. 3—TEST OF TWO OPEN-END FLUME METERS
The test showed the correctness of the formula, $q = ch^n$

lated and after that used for all depths. This calibration can readily be done with either a current meter, a pitot tube or a weir.

For rectangular channels an exponent of about 1.7 is approximately correct for a wide range of widths, in which case it is only necessary to determine one flow in order to obtain the constant coefficient. It is not essential to determine the depths at any given distance from the outlet. If the channel is to be calibrated, this distance can be selected at any convenient point.

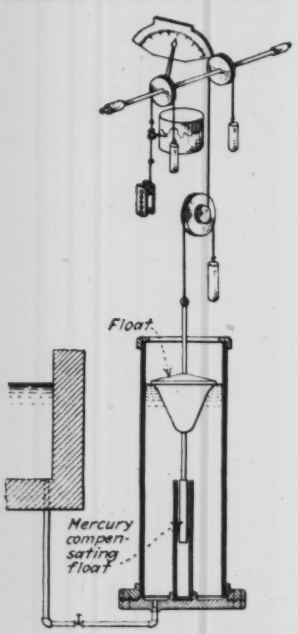


FIG. 4—OPEN-END FLUME, INDICATING, RECORDING AND TOTALIZING METER

On account of the sharpness of the curve of the surface of the water it is advisable that the reference be at least 18 in. upstream from the outlet of the channel, but above this distance it is believed the accuracy would be just as great if the depths were taken at any point in the channel, even a thousand feet, or a mile, from the outlet. This conclusion is not jumped at but was first arrived at from deductive reasoning and then verified by three series of flow experiments, made as follows: Having the complete results made with the 15-in. flume, the end of the flume was partly blocked off by placing a vertical rectangular opening in the end of the flume, 5⅞ in. wide. The formula was then found to be $Q = 1.46\ d^{1.503}$, which held true for all depths taken 120 in. above the obstruction. With the second set the opening was 3 in., the formula being $Q = 1.00\ d^{1.7}$. With the third set the opening was 10 in. and the formula was $Q = 4.23\ d^{1.503}$.

It will be readily seen that this device lends itself to the measurement of water for irrigation purposes, or any situation where the water passes through a flume. It is easy to construct. It has not the limitations of a weir and requires less head.

A very simple meter register (Fig. 4) can be connected with the flume at any distance from it, provided the level of the water in register chamber is the same as that in the flume.

California Begins Construction of Douglas Memorial Bridge

State Highway Commission Lets Contract for Building Reinforced-Concrete Structure Across the Klamath River

BY HARLAN D. MILLER
Acting Bridge Engineer, California Highway Commission

THE CALIFORNIA Highway Commission has recently let a contract for the construction of a half-million dollar memorial bridge over the Klamath River in northern California, which will consist of five 210-ft. open-spandrel reinforced-concrete arch spans, supported on a wood-pile foundation. Very seldom have fixed concrete arches of so long a span and of such great weight as these arches been constructed on a pile foundation and for this reason the design has attracted much attention and the construction of the bridge will be watched with interest.

The bridge will be known as the G. H. Douglas Bridge, in memory of a great public servant who long advocated its construction. It will be located about three miles up the Klamath River from the ocean, on the main trunk highway connecting the states of Oregon and California and will serve the ever-increasing traffic on this Pacific Coast route. A ferry system is at present the only means within many miles for crossing the Klamath River and this inefficient service is often subject to interruption at periods of low tide.

The cost of the bridge will be borne partly by the state of California and partly by the federal-aid funds, a fact which made necessary the approval of the design by the Bureau of Public Roads. The river being considered navigable, it was necessary to secure permission from the War Department to construct the bridge and to comply with its requirements in regard to clearances.

Design Considerations — Transportation considerations and availability of materials were two factors which greatly affected the design. There are no railroads within many miles of the bridge site and transportation of material by water is impracticable. The availability of good aggregate at the site, and the extensive timberland furnishing lumber for falsework and piles at little cost, made a concrete design more economical than one of steel; and the prevalence of salt-air fogs made a concrete structure appear more practical for this crossing.

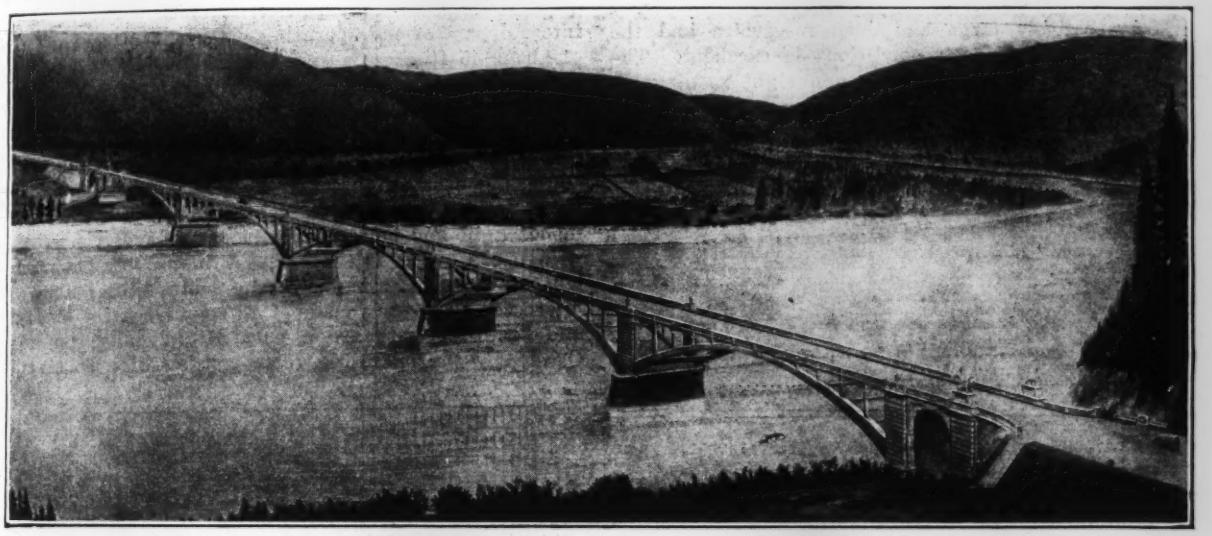
The Klamath River flows through a mountainous region which is covered by a virgin forest of enormous redwoods, in fact the largest and oldest trees in the world grow in the forests in this region, so that in times of flood there are quantities of large drift. Tree trunks 10 ft. and over in diameter and 100 ft. or more in length line the river banks near its mouth. Such heavy drift made long spans imperative.

Considerable study was given to the matter of loca-

tion as this bridge will be the only bridge over the river for over 100 miles from its mouth. At the site chosen for the bridge the river is approximately 1,200 ft. wide. The maximum depth of water near the center of the river at periods of low water is approximately 30 ft. The bed of the river is composed of gravel and sand to considerable depth.

Physical Features—The artist's sketch shown herewith shows the bridge as it will appear when completed. Ornamentation has been made simple so that the structure may harmonize with the ruggedness of the country. Figures of California grizzly bears will probably be placed at the ends of the structure.

The bridge will contain approximately 9,000 cu.yd. of concrete and 425 tons of reinforcing steel. It will have a clear roadway width of 21 ft. The roadway at the center of the bridge will be 50 ft. above low water and over 80 ft. above the base of the piers.



ARTIST'S CONCEPTION OF DOUGLAS MEMORIAL BRIDGE WHICH WILL SPAN KLAMATH RIVER IN CALIFORNIA

A floor slab 7¾ in. thick will rest on caps supported by spandrel columns. Four floorbeams will span bays between the caps. In addition to the expansion joints at the ends of each span, there will be four expansion joints through the concrete roadway over each arch. Bronze expansion plates will be used in all cases. The spandrel columns will be rectangular in cross-section and will have a batter of 1.8 in. to the foot. The columns will be spaced equally at distances of 18 ft. 4 in.

The arch spans will be 210 ft. in length c. to c. of piers and will have a rise of 30 ft. 10 in. Each of the two ribs will be 4 ft. in width. The crown depth will be 4 ft.; the depth at springing, 8 ft. Rectangular stirrups placed radially will enclose the reinforcement along the intrados and extrados. On account of heavy drift, the springing lines of the arches will be kept as high as possible and a diaphragm 18 in. in thickness and 20 ft. in length will be placed between the arch ribs at the springing to prevent the wedging of drift between them.

Pier Design—The piers are to be of hollow construction, each supported on approximately 250 timber piles. The piles are to be driven to a bearing capacity of 24 tons based on the *Engineering News* formula. The piles were cut in the Government forests near the bridge site by Indians from the Klamath Indian Reservation. The piles were cut in winter to insure greater strength and were furnished to the bridge contractor by the California Highway Commission. One thousand of these piles are 60 ft. or more in length.

After the piles are driven within the cofferdam it is proposed to cut them off at various elevations in order to prevent a plane of weakness in the footings. Cofferdams will be sealed with tremie-placed concrete of sufficient thickness to withstand the hydrostatic pressure. The cofferdam will then be unwatered and the rest of the concrete deposited in the dry, the base of piers being approximately 30 ft. below low water. The arches will be poured by the voussoir method using concrete blocks set on the neutral axis between voussoirs to prevent movement and buckling of the steel reinforcement. All arches are to be poured simultaneously. They will also have their centering struck at the same time in order to avoid unbalanced thrusts on the piers.

Loading—The bridge has been designed for a dead-load plus a live-load consisting either of two 15-ton trucks or of a uniform live-load where higher stresses were produced by the latter. For a loaded length of 50 ft. or under the uniform live-load used was 130 lb. per square foot of roadway surface; for a loaded length from 50 to 100 ft. a uniform live-load of 90 lb. per square foot was used; for a loaded length from 100 to 200 ft. a uniform live-load of 70 lb. per square foot. Proportionate loads were used for intermediate lengths. An impact factor of approximately 30 per cent was allowed. A fall and a rise of 35 deg. F. was assumed in calculating stresses due to temperature variation. Stresses induced by the shortening of the arch ribs were also considered.

The piers, arch and roadway will be constructed of Class "A" portland cement concrete of a 1:2:4 mix; the two abutments of a 1:3:6 mix; and the railing of a 1:2:3 mix.

The unit stresses allowed in the structure were 650 lb. per square inch in the case of concrete and 16,000 lb. per square inch in reinforcing steel, save where rib shortening and temperature stresses were considered a maximum stress of 750 lb. per square inch was allowed for concrete in the arches.

Operation of Slow Sand Water Filters at Hartford, Conn.

Stored Surface Water Filtered at Rates Averaging 4.54 M.G.D. in 1923 With Maximum of 20 M.G.D. and at Average Operating Cost of $4.61—Color Removal 41.7 Per Cent for 1922 and 1923

By Caleb Mills Saville
Manager and Chief Engineer, Water Department, Hartford, Conn.

THE HARTFORD slow sand filtration plant has now been in service for over two years and may be said to have become "tuned up" as regards operation. As it is one of the latest slow sand plants to be constructed, and as it removes considerable color, the operating results are of interest.

The raw water coming to this plant is gathered entirely from surface runoff of hilly, glacial country, with very little swampy area. This water is stored in comparatively large and deep reservoirs and the exposure to atmospheric conditions is excellent. The plant consists of a jet aerator and eight rectangular beds of about one-half acre each. After filtration the water goes to a covered clear water basin with a capacity of about 6.2 m.g. On leaving the clear water reservoir on its way to the city the water passes the chlorine gas house, from which it receives 0.1 p.p.m. of gas. This amount is injected, not for its sterilizing value, but as a safeguard to assure that the automatic chlorine apparatus is in working order and ready for an emergency. The raw water is of most excellent character, practically no turbidity, comparatively low color, and because of sparsely populated watersheds under constant supervision and through long storage in the reservoirs it is a more than reasonably safe water without further treatment. The citizens of Hartford, however, desired not only a safe water but one that should be clean as well. While a reasonably low colored water was expected, the principal requirement was to avoid artificial treatment and so far as possible duplicate nature's processes. No coagulants of any kind are used with Hartford water, long storage and natural [slow sand] filtration producing a satisfactory effluent at all times. (The plant was described in *Engineering News-Record*, Sept. 7, 1922, p. 380.)

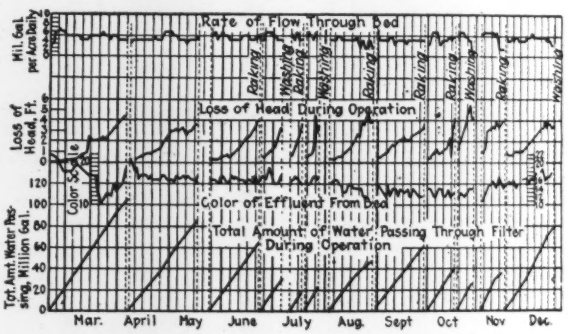
TABLE I—OPERATING COSTS OF SLOW SAND FILTRATION, HARTFORD, CONN.

	Labor	Materials	Total	Per M.G.
Filter operation	$13,367	$2,452	$15,819	$2.7439
Filter maintenance	286	.....	286	.0496
Power plant operation	4,389	162	4,551	.7894
Power plant maintenance	610	.....	610	.1058
Plant costs	$18,652	$2,614	$21,266	$3.6887
Allowing 25 per cent overhead for general supervision, general office and supplies, and incidental work, including a proportion of the general overhead of the entire water supply system				.922
Cost for 1923, per m.g.				$4.61
Cost for 1922, per m.g.				5.15
Cost for first four months of 1924, without overhead				3.15

TABLE II—AMOUNTS FILTERED AFTER WASHING AND AFTER EACH OF FIVE RAKINGS

Quantities passing filters, m.g. per bed	After Washing	After Raking				
		First	Second	Third	Fourth	Fifth
Average	70.4	50.6	51.5	52.8	43.5	32
Maximum	147	83	110	113	93	39
Minimum	23	21	24	18	22	25

The beds are from 3 to 4 ft. thick, with sand having an effective size of about 0.29 mm. and a uniformity coefficient of 2. For washing the filters, ordinary ejectors are used, sending the dirty sand to Nichols washers and from these either to an empty bed or to an outside sand pile. Ordinarily the sand is washed twice—once as it comes from the bed and again as it is delivered. The filters are piped with hydraulic pressure sand pipes, and by these the sand can be delivered from any bed to any other bed or to the outside sand pile. Power is obtained from a hydro-electric station which is an integral part of the operating plant and utilizes a fall of about 45 ft. from a reservoir abandoned as a regular source when the new supply was put in service. This plant has two turbines: one a 15-in. Morgan Smith direct-connected to a 150-kva. 600-volt generator; and the other a 9-in. Holyoke belt-connected to a 25-kva. 600-volt generator, the current being 3-phase alternating. Besides power for filter operation, the plant furnishes light and power for various demands connected with operation of the works. A thoroughly equipped laboratory is maintained in the main filter building. Microscopic tests are made of all supply sources weekly and bacterial tests are a part of the daily routine. Ordinarily the operating force consists of a foreman, a part-time laboratory operator, two night watchmen (8-hr. shift) and three day employees, whose duties comprise upkeep of rather extensive grounds as well as operation of the plant. When it is necessary to wash sand a crew of about eleven men is requisitioned from one of the pipe-laying gangs.



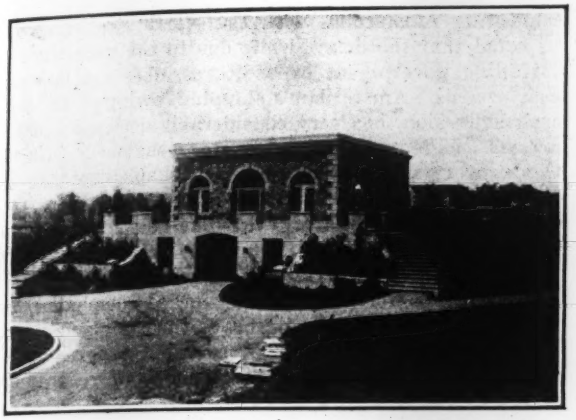
RECORD OF FILTER BED 5 FOR YEAR 1922

In the cleaning process beds are both raked and washed. The regular day crew attends to the raking and will rake a bed in about two hours. To wash a bed and remove the sand 11 men are used, occupying about two 8-hr. shifts. During the year 1923 there were filtered 5,765 m.g. of water at an average rate of 4.54 m.g.d. per acre. Table I shows the cost of filtration, exclusive of interest and depreciation charges.

The decrease in operating cost reflects the gradual increase in efficiency due in part to the plant's "finding itself" but more especially to the interest taken by the foreman and his regular force in getting results.

During 1923 and 1924 maximum rates of 20 m.g.d. were required from the plant.

Hartford's water supply system is very advantageously situated for elastic operation, and the filters were designed and planned to take advantage of these conditions. Two main supply sources are available and distinct from each other, either of which can be used separately or both together. By this means raw water can be taken from that source which is lower in microorganisms at the troublesome periods, and so far as possible that source with the lower color is used either in whole or mixed in given proportions with the other.



GENERAL VIEW OF HARTFORD FILTER BUILDINGS

TABLE III—COLOR REMOVAL BY SLOW SAND WATER FILTERS AT HARTFORD, CONN., 1922–24

	Raw Water			Filtered Water			Per Cent
1922	Max. Weekly	Average Monthly	Min. Weekly	Max. Weekly	Average Monthly	Min. Weekly	Color Removal
July	..	26	..	..	15	..	42.3
Aug.	..	25	..	..	14	..	44.0
Sept.	..	25	..	..	14	..	44.0
Oct.	..	22	..	..	13	..	40.9
Nov.	..	25	..	..	14	..	43.4
Dec.	..	33	..	..	16	..	51.5
1923							
Jan.	..	33	..	..	18	..	45.4
Feb.	..	28	..	..	17	..	39.2
March	..	25	..	..	16	..	36.0
April	..	27	..	..	17	..	37.0
May	..	28	..	..	16	..	42.8
June	..	16	..	..	10	..	37.5
July	..	18	..	..	9	..	50.0
Aug.	..	19	..	..	11	..	42.1
Sept.	..	20	..	..	11	..	45.0
Oct.	..	14	..	..	9	..	35.7
Nov.	..	22	..	..	11	..	50.0
Dec.	..	26	..	..	13	..	50.0
1924							
Jan.	32	27	22	17	17	16	37.1
Feb.	24	23	20	17	14	12	39.1
March	26	25	25	19	18	18	28.0
April	27	25	24	16	16	15	36.0
May	25	21	20	16	13	12	38.0
June	24	23	22	16	15	14	34.8
July	..	22	..	..	15	..	31.8
Median	..	25	..	..	14	..	44.0
2-yr. average	..	24	..	..	14	..	41.7
Maximum	..	28	..	..	18	..	51.5
Minimum	..	16	..	..	9	..	28.0

In operation, when the loss of head through the filters becomes nearly equal to the depth of water over the sand the bed is emptied and raked. After raking, usually four times, the top layer of from 1 to 2 in., depending on the season of the year and the conditon of the water, is scraped off, washed and delivered as described above. It has been found that the fifth raking is not economical.

During 1923 there were 23 washings and 80 rakings; the delivery conditions after each are shown in Table II.

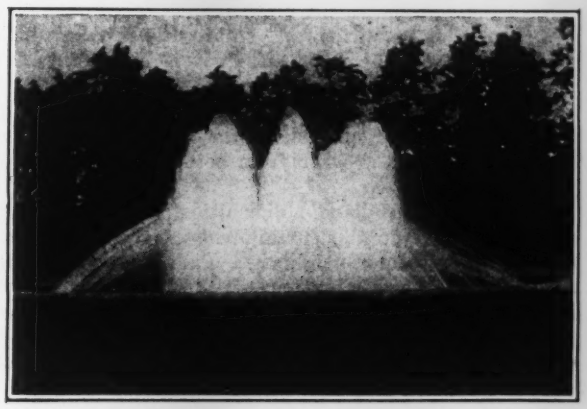
During 1923 about 2,775 cu.yd. of sand were washed at a total labor cost of $4,375, equivalent to $1.58 per cubic yard of sand and 76c. per million gallons water filtered. Recent improvements have been made in operation, so that at the present time the sand washing only is costing less than $1 a yard. In washing and moving the sand about 1,500 gal. of water are used per cubic yard of sand removed. A motor-driven centrifugal pump supplies water for washing operations at 130 lb. pressure at the ejector.

Table III gives the color of the raw and filtered water supplied to the city for the past two years.

The actual rates at which the several filters were operated on July 31, 1924, and corresponding data for color removal and raking are shown by Table IV.

Prior to the introduction of the additional supply and the installation of the filters the mean color of the supplied water was 33; for 40 per cent of the time it ranged between 11 and 25, for 43 per cent between 26 and 50, and for 11 per cent above 51.

As between an average color of 14 and one of 8 or 10, which is sometimes considered a criterion, without turbidity there is little or no difference noticeable to the ordinary consumer. With slow sand filtration the Hartford water is not "aggressive"; no precautions have to be taken against corrosion of service pipe and constant expert and high-priced attention is unnecessary in running the plant. The capacity of the present plant is being reached and studies for additions of similar construction are now being made. Possibly in the future it may be desirable to put in prefilters without use of coagulant to cut cost by running the present filters at a higher rate than at present.



AERATOR WITH ALL JETS IN OPERATION
The basin is about 40 ft. in diameter

TABLE IV—RATES OF FILTRATION, JULY 31, 1924

Filter	Rate M.G.D. Per Acre	Head Lost in Filter Ft.	Color of Water: Raw	Color of Water: Filtered	Times Raked Since Washing
1	5.7	3.0	22	15	2
2	6.6	0.6	22	14	1
3	5.7	0.9	22	16	1
4	5.7	0.8	22	16	2
5	3.8	3.8	22	17	0*
6	5.7	1.4	22	16	3
7	4.7	0.8	22	15	4
8	Raking, bed out of service.				

Average rate of filtration, 5.4 m.g.d. per acre.
Average color filter effluent, 15.5.
Per cent reduction color 29.5.
* Bed 5 is next to receive attention.

It is recognized that only with waters from a few localities can the results be had that are being obtained in Hartford, due to a combination of very advantageous circumstances.

Notes from Foreign Fields

Holland's Post-War Difficulties

By E. J. Mehren
Vice-President, McGraw-Hill Co., Inc.

THE innocent by-stander often is hurt. So it was with Holland during the war. So it is now. Holland, in common with the former belligerents, is suffering from the effects of the world's decreased purchasing power.

During the war, it will be recalled, Holland suffered severely. She had no military participation in the conflict, but her economic relations with all the world were disrupted. Her food supply was diminished and strict rationing was necessary. So she shared the war hardships.

After the war her course, economically, followed that of the other nations. She had a period of hectic activity, construed, at the time, as an evidence of prosperity. Then came the slump—and Holland has not even yet fully recovered.

She suffers, as does England, from fairly large unemployment and from labor inefficiency. But the attitude toward their problems is a hopeful one. The Hollanders say that labor conditions are improving. Wages have come down from the peak, efficiency is increasing, and hours of labor, though fixed at 45 per week by law, have been increased in a few cases. The turn for the better in the labor attitude seems to have come, even though conditions are far from being as good as they were before the war.

Economically, Holland's difficulties, as already suggested, are due to the curtailment of the purchasing power of her former neighbors. Particularly does she suffer from the diminution of the German market. Here again the Hollanders are hopeful, for German trade is picking up a little. The stress due to the introduction of the stabilized rentenmark is beginning to ease and purchasing is being resumed. Nevertheless, trade is far from normal and the country is running at reduced activity.

Dearth of Large Projects—Of large projects there are practically none, whether undertaken by private industry or by the government. The only large private enterprise under way in recent years—a blast furnace plant of 500 tons capacity, the first furnace in Holland—is now completed and in operation.

The building of the great new lock at Ijmuiden has practically been postponed—though some small parts of the work are going on, while the draining of the Zuyder Zee is progressing at a rate much slower than was contemplated.

It is interesting to note, by the way, that the blast furnace was suggested by the war, as a means of insurance for the iron supply of Holland's industry. Coke is secured from Dutch coal, but limestone and ore must be imported.

There is more or less debate about the economics of the plant. Some believe that there is a future for iron production in Holland, but I took it that the prevailing opinion was that while this was the first plant in Holland it was probably also the last. Water-carriage for the limestone and ores is, of course, quite cheap, since the plant is on tide water. Undoubtedly, there are European plants with more favorable conditions for the assembly of materials. Nevertheless, to date a market for the pig iron has been found against other competitors, and some of it has been exported.

In regard to the new lock at Ijmuiden, on the canal connecting Amsterdam with the North Sea, it should be noted that the delay, while due to the necessity for curtailing government expenditures, does not now appear serious. Amsterdam's shipping, owing to the general depression, has very considerably declined and the present lock is more than adequate to the needs. Unless the recovery should come with remarkable rapidity, the lock will not be far behind the demands made upon it.

At the Zuyder Zee work, the dike between the mainland on the west and the island of Wieringen (erstwhile abode of the former German crown prince) is, after four years of work, well along toward completion, but the main dike, from the island to the mainland on the east, is not yet in hand. More rapid progress is in abeyance due to the government policy of reduced expenditure.

Highway Program—Only one considerable new enterprise is under consideration, an extension of the government's assistance to the construction of new roads. The funds for this are to come from a motor-vehicle tax. A report recommending the tax and the road program has been made by a special commission, and it is expected that the legislation will be forthcoming. At present the government aids road work to the extent of 2,000,000 guilders per year. The new taxes are to raise 5,000,000 guilders, and this sum, in addition, will be available for road work, some of it on a co-operative expenditure basis for improvements and some for maintenance. The new work, as well as that now supported by the government, will be under the direction of Heer G. J. van den Broek, who has been made chief engineer of the government Road Bureau. Heer van den Broek will be remembered by the waterway engineers of the United States for the extensive canal and lock studies he made there some years ago, in company with Jhr. van Panhuys.

The Larger Problem—Even aside from present conditions, Holland has a large economic problem before it. The population is increasing quite rapidly, but the country has no colonies of its own to attract immigrants. Its only considerable colony is the Dutch East Indies, but their tropical climate is impossible for laborers and mechanics. Of course, some Hollanders are emigrating to other countries and will be lost to Holland, but the inducement to emigrate would be greater if there were inviting Dutch colonies to go to.

It would be logical under these conditions for the country to become more largely industrial. Thus far it has been mainly agricultural, but development in that direction cannot be extensive. The lands to be made by the Zuyder Zee drainage will offer but a small measure of relief.

Economically, therefore, the problem is pressing and its solution is likely to have very important results for Holland.

Effect on Engineers—The restricted industrial and construction activities naturally affect engineers. The government technical college, at Delft, is graduating about 280 men a year. About one-third of them go to the Dutch East Indies, and about five per cent to other countries. The remainder have to be absorbed by home

industries and enterprises. With the curtailed activity, recent graduates are having "hard sledding."

The older engineers, as in England, have less difficulty in finding employment.

In regard to engineering education, I learned from Professor S. G. Everts, president of the Royal Institute of Engineers (Koninklijk Instituut von Ingenieurs), that there are 2,000 students at Delft and that the course is five years. Courses in civil, mechanical, electrical, mining, and chemical engineering are given, though I gathered that the specialization is not as sharp as with us and that the men in each of the courses get a sound grounding in the fundamentals, at least, of the other specialties. No cultural studies whatever are given in the engineering colleges. This is explained by the fact that their secondary school education is more thorough and more extended than ours. The young men enter Delft at the age of 19, having had, among other studies, thorough courses in English, French, and German (I have yet to meet a Delft man who did not speak these three languages well). Professor Everts complained, and in this he was joined by Heer P. J. Ott de Vries, treasurer of the Institute, that the young men graduated too late—at the age of 24. While they admitted some advantage in the greater maturity, they believed it better to get the young men into practice earlier.

The Institute, to whose officers reference has been made, embraces all branches of engineering except one; the chemical engineers have their own society. There are nearly 3,000 members, of whom 500 are in the Dutch East Indies.

The prosperity of the Institute is indicated by its purchase two years ago of a new home. The building was a large residence built two hundred years ago, and the various rooms have the imposing dimensions of the mansions of that period. Certain improvements and restorations have been carried out, so that the building now serves well for the offices, library, and smaller meetings of the Institute. There is needed only a large auditorium for the large meetings, but ground is available for an addition to the building in which such a hall could be included.

Some years ago I had a reception in Holland that abounded in courtesy and thoughtfulness—a never-to-be-forgotten picture of Dutch hospitality. The experience was repeated on this visit. I had written Heer van den Broek that I was to be in Holland. He immediately arranged with Jhr. C. E. W. van Panhuys, director of the Government Drainage Bureau, for an excursion over the roads and to some of the drainage projects near The Hague. But that was not all. The secretary of the Institute, Heer R. A. van Sandick, and his wife called at the hotel upon my arrival, while later in the day I returned the call at the Institute's home and was presented to the president and the treasurer. The president is an officer of one of the large construction companies, and during a long visit answered patiently and fully the questions with which I plied him.

The hospitality was most gracious and made one feel perfectly at home. One could not feel strange in a country where the hand of friendship was so freely extended to smooth the path of business and professional inquiry.

The Hague, July 25, 1924.

Making Terra-Cotta Cornices and Parapets Structurally Safe

TROUBLES arising from the use of glazed terra cotta for the cornices and parapet walls of large buildings, with methods for avoiding these troubles, are presented in the following abstract of a paper read at a meeting of the National Terra Cotta Society by Gerhardt F. Meyne, contractor, Chicago.

ALTHOUGH terra cotta is an excellent embellishment and building material, my observations in reclaiming such terra-cotta work as parapet walls, pediment walls and large projecting cornices in Chicago show that when this work is not properly installed it can in a few years become a menace to the public. If the building department knew the condition of many of these large cornices the sidewalks would be roped off until repairs were made. The difficulty with the cornices has been that exposed vertical joints not properly sealed have permitted the intrusion of moisture which has rotted out anchors, supporting rods and even the supporting structural steel. All exposed vertical joints should be calked, sealed with an elastic cement and then covered with either copper or sheet lead. I have found anchorages in good condition after thirty years of service when not exposed to water, even though not protected by paint or surrounded by brick or mortar. There is seldom any deterioration of anchors or supporting steel under the horizontal joints, water being excluded by the high-grade putty or cement mortar generally used, or the joint (being visible) is painted. Setters of terra cotta should be instructed to dip each anchor in paint before applying it.

Parapet and Pediment Walls—Troubles with parapet walls and pediment walls come from exposed vertical joints in the coping, allowing rain water to enter. When price does not allow calking and painting with elastic cement, the vertical joints should be filled solid with a good cement mortar. We have found walls faced and capped with terra cotta, getting out of plumb in amazing fashion. But in ordinary walls covered with salt-glazed coping we have found no deterioration except ordinary wear and tear. There are several causes for this: (1) The face terra cotta was not properly backed, (2) the backing material was of inferior quality and did not have the same coefficient of expansion as the terra-cotta facing, (3) the mortar was inferior, (4) the back of the wall had been tarred, (5) the coping did not give sufficient drip.

All terra-cotta work should be properly backed and should not depend on the anchorage alone to hold it in place. Brick and mortar should be shoved into the hollow parts to make the embellishment as nearly as possible a part of the structure, particularly on pediments and parapet walls.

If a high-grade impervious material laid in cement is used for one side of a wall and soft common brick in lime mortar for the other side, it cannot give good service. The trouble would not show up so quickly but for the practice of tarring parapet walls, with the idea of preserving them. With the air thus excluded, the lime mortar remains soft. In winter, ice crystals expand the joints and the bond is broken; the sun's rays in summer help draw the wall toward it; the fall rains get into the cracked bond and horizontal joint; the next winter's frost usually shows an overhang of an inch or two and the process continues. Where walls are thoroughly seasoned, tarring is good practice.

Coping should be wide enough and with a properly made drip in order to protect the wall. There are many places in Chicago where it would be easy to take bricks out of a parapet wall by scratching away the mortar with a penknife, because insufficient coping projection has allowed water to run down the wall and the winter frost has got into it.

British Death Rate at New Low Record

The general death rate for England and Wales was 11.6 per 100,000 in 1923, establishing a new low record. The infant mortality rate was 69 per 100,000.

From Job and Office

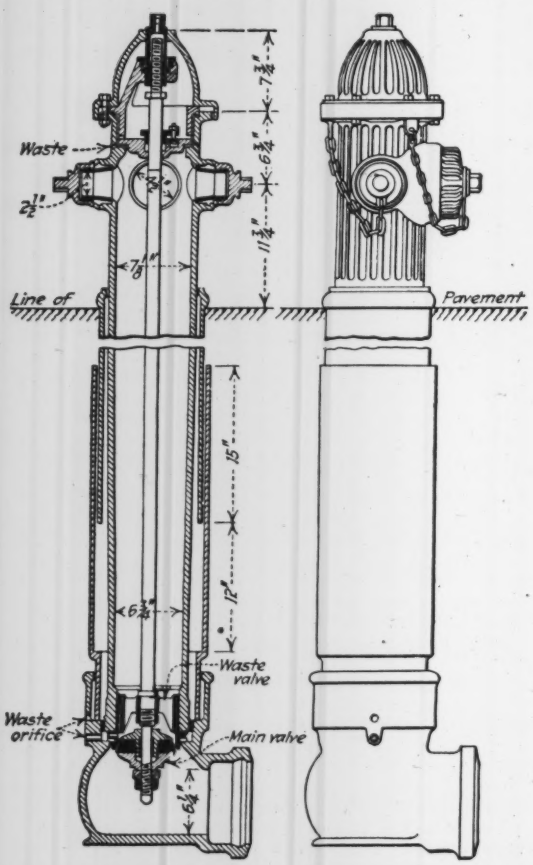
Hints That Cut Cost and Time For the Contractor and the Engineer

Hydrant Modified for Looks, Adjustability and Visibility

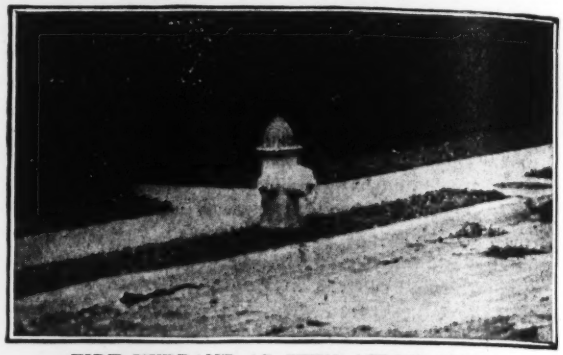
By Robert B. Morse
Chief Engineer Washington Suburban Sanitary District, Hyattsville, Md.

SOON AFTER the commencement of construction work on the water and sewerage systems in the Washington Suburban Sanitary District the need of fire hydrant standardization was felt. Within the area of 100 sq.mi. in Maryland covered by the district, several thousand hydrants would have to be installed in a comparatively short period. That number would increase, year by year, with the rapid development of this suburban section.

No fire hydrant on the market seemed to the writer to have all the characteristics required: appearance, ease of adjustment to changing street grades, and visibility, with the usual qualities of capacity and mechanical competency. The fire hydrant is really a noticeable feature of the urban landscape. The public should welcome a combination of striking and pleasing appearance. It is desirable, above all, to avoid the monstrosities that extend so far out of the ground, and the nearly buried nozzles, both so much in evidence in many cities—and to do so with a minimum of expense.



WASHINGTON SUBURBAN SANITARY DISTRICT HYDRANT
Mathews fire hydrants redesigned to give good appearance and visibility and provided with sliding frost case for adjustment to street grades, when set or in the future; range of adjustment, 24 in. One scheme of painting, to be described in a later issue, chosen to suit various color backgrounds.



FIRE HYDRANT AS SEEN ACROSS STREET
Note good visibility as set in grass strip, alongside concrete sidewalk and curb, with hedge as background.

The best method of approach appeared to be through the Mathews hydrant. The standpipe can be easily removed, but if the ground level is raised materially the frost case has to be dug up and changed also, unless allowance is made at the time of installation, by the use of a long hydrant or a shallow setting. This injures the appearance of the hydrant. Lowering the ground surface after installation produces the same effect.

In order to meet uncertainties of street grading, and in an effort to improve general appearance, the standard Mathews hydrant was re-designed. At first, the standpipe was changed by eliminating the bead, tapering slightly the cross-section below the ground, and altering radically the design of the outside surface. That part of the hydrant appearing above the ground was shortened and the top cap was changed. The new design included only such modifications of the revolving nut, stuffing box and stuffing box plate, as became necessary incidentally.

This district installed many of these hydrants, with considerable satisfaction. It occurred to the writer, however, that a much greater degree of adaptability might be attained if the frost case could be raised or lowered to conform with changing street grades. A study convinced him of the practicability of a sliding frost case and all hydrants now installed include it.

All hydrants placed by the Washington Suburban Sanitary District are of the so-called "5-in." size. The main valve opening is 5¼ in. in diameter. Most of the standpipes in use are for hydrants of 5-ft. bury. Frost cases have a sliding range of 24 in. When extended as far as practicable, the lower section laps over the upper a distance of 3 in. The drawing shows a hydrant with frost case in mid-position. Any length of hydrant from 4½ to 6½ ft. may be used with the frost case adopted by this district, without varying the appearance at the surface. If it should happen that the ground surface

is lowered a small amount below the bottom of the bead on the frost case when entirely collapsed, the appearance would not be particularly bad—certainly no worse than many of the settings ordinarily seen.

By the use of these frost cases with standpipes of proper length it is possible to make a neat adjustment to existing ground surface and at the same time prepare for any reasonable grade change. The utility of such an arrangement will be evident to anyone who has tried to decide how somebody else would grade a particular street in the future, or who has dug down to replace hydrants on account of grading. All that is necessary is to use a fair degree of judgment when installing a sliding frost-case hydrant. Adjust the frost case in an extended or collapsed position, either fully or partly, depending upon the amount of excavation or fill, respectively, that may appear probable at any location. Whenever the ground elevation is changed sufficiently to make an adjustment desirable, insert a new standpipe and raise or lower the upper section of the frost case as required. A small amount of excavation near the surface will make this possible. Where there is danger of settlement around the hydrant, it is well to leave the frost case slightly high, or to insert thin wedges between the standpipe and the upper end.

In this district most water mains have to be laid before streets are permanently paved and many before sidewalks are constructed. Some are installed in advance of the rough grading of streets. The sliding frost-case hydrant is particularly applicable where such conditions obtain, and it is known that they do occur in many places, especially in small towns and in rapidly growing suburban sections. Even where finished sidewalk elevations are determinable, the use of these hydrants permits of so close an adjustment to the surface that a uniform and particularly pleasing effect is produced, as witnessed by the view.

In developing this fire hydrant, and particularly in translating the writer's ideas into practical detail, material aid was given by Charles H. Becker of R. D. Wood & Co.

Portable Sawmill Puts Recalcitrant Pump To Work

By L. L. Tribus
Tribus & Massa, New York City

SOMETIMES amid the tragedies of practice come the amusing incidents.

On a recent quiet Sunday afternoon came a long distance call, "Come as soon as possible, club and camp's out of water."

SAWMILL ENGINE HITCHED TO WELL SUPPLY PUMP

One hundred miles by rail and twenty-five by motor reached the large club reservation, where dependence had been upon two individual camp wells, a fairly active spring, and the balance of 160 people served from one 6-in. bore, yielding 13 g.p.m., when the 1½-hp. engine could be persuaded to operate the deep well pump. The engine had decided not to work, hence the 'phone call.

Before the writer reached the spot certain club members had borrowed a portable gasoline sawmill and had rigged it up with a long flapping belt, so that Mr. Pump lost his holiday.

A wife of one of the members heard that a sawing machine had been borrowed, so expressed surprise and gratification that at last woman's pride, a "sewing machine" had been turned into a helpful pumping engine.

Quality Too Often an Overlooked Factor in Water-Works Operation

By L. A. Geupel
Director, Water and Sewage Department, Indiana State Board of Health, Indianapolis

THE BUSY water-works superintendent is faced with so many and such various problems that he is likely to forget the most important of all, uninterrupted maintenance of the quality of the water. A few of the many avenues of infection against which he should be on constant guard will be mentioned.

Supplies from deep wells should be examined more than once or twice a year. The public should know at least four to six times a year that the water they drink is satisfactory. All piping and equipment open to the slightest hazard of pollution should be tested often for its detection and if there ever is any doubt about its presence or likelihood in the superintendent's mind, an analysis should be made and the public at large informed through publicity of some character, generally an article in the local papers. Engineers are aware that joints on suction lines may develop leaks, casings may admit surface pollution through corrosion, or carelessness on the part of operators may yield polluted water and numerous other mechanical failures may occur which always throw the public open to an unknown hazard if the water becomes contaminated. All these possibilities should be investigated repeatedly. This is all the more important because unfortunately there are still men in charge of plants who cannot read understandingly an analysis of their own supply although they could find and remove danger points of a physical character. A number of incidents of pollution have occurred unknown to the men in charge. Such accidents should be studied so that they will be held to a minimum.

Mechanical filtration plant operators are generally aware of the hazards of bad water yet there are many plants which do not have laboratory control. There are filter plants in operation which deliver a clear water and whose operators still believe that laboratories do not know their business when they say that clear water may contain bacteria. In those plants having laboratories operators are aware that 24 to 48 hours of bad water may be delivered before the bacteria tests indicate danger. Practically every surface supply settled and filtered is now treated with chlorine or sterilized by other methods. Operators must use a chemical test to determine whether the sterilization is doing the work.

The ortho-tolidin test for residual chlorine, even though spoken of adversely by many higher technicians, is used with success in many plants. It is essential that the filter operator know each day the quality of the water delivered and that by carrying a residual chlorine (where chlorine is used) of a certain amount, which if possible does not create odor or taste in the supply and does exterminate bacteria, he be reasonably certain of the character of his supply. Operators have been known to place the same amount of chlorine daily in the water per million gallons treated no matter how bad the condition of the raw water. Every operator should be up-to-date on matters pertaining to the treatment of his own supply. Efficient technical control is cheap in the long run though it sometimes interferes with the patronage appointments in vogue in many municipal plants.

The superintendent of mains, along with his other repair difficulties, is often faced with the need for a hurried finish to restore service. Many times breaks have been repaired in grossly polluted ditches and no effort made to flush the bad water from the polluted section of main. A thorough knowledge and avoidance of the dangers of such practices may promote a healthy community.

Intake Shaft and Screen House for Portland Water District

By Charles B. Mitchell
Resident Engineer, Sebago Lake, Me.

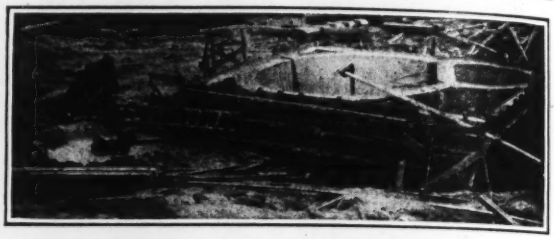
A NOVEL and interesting design for an intake shaft and screen house has been adopted by the Portland (Me.) Water District for its new intake conduit at Sebago Lake. The conduit is divided in three sections. The intake section consists of 54-in. concrete pipe extending 1,600 ft. into the lake at an average depth of 25 ft. below mean water level. Sect. II is a rock tunnel extending 2,100 ft. from the shore to a natural basin, a swamp. This tunnel is to have a concrete lining with a 60-in. bore. Sect. III consists of 1,900 ft. of 54-in. concrete pipe across the swamp, connecting the portal of the tunnel with the mains which carry the water to Portland, 16 miles distant.

The intake shaft and screen house is located at the shore of the lake, and connects Sect. I and II. The present intake is about 1,000 ft. from the new one, and, during the winter months, a great deal of trouble is caused by small fish being carried against the screens by the current, thereby necessitating a man on watch 24 hours a day, continually cleaning the screens. These are of the sliding type, and have to be lifted and cleaned, sometimes as often as every two hours.

After carefully studying several designs, the following was finally decided upon. A structure was built which could be used both as a shaft for the tunnel and as a chamber for the screens. This consisted of a circular, concrete shaft having an inside diameter of 18½ ft. with 18-in. walls. A cofferdam of 30-ft. steel sheet piling was driven to rock and the shaft constructed. The 18½-ft. diameter section extends from Elev. 274 or floor level to Elev. 242, which is a concrete floor resting on rock. From Elev. 242, a 7½-ft. diameter shaft was sunk to Elev. 232, which is the invert of the tunnel section at this point. About this smaller shaft, five piers were built with guides for

From Job and Office

Hints that Cut Cost and Time

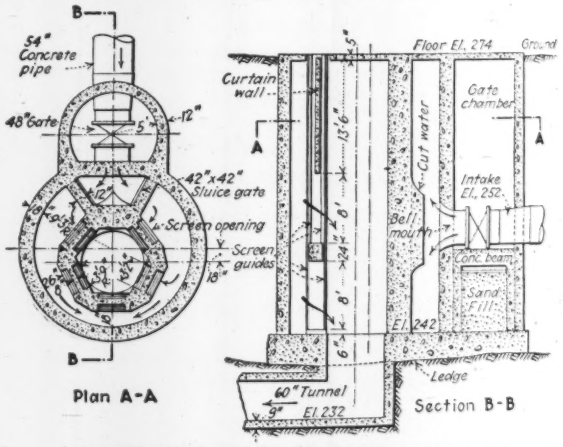


INTAKE SHAFT AND GATE CHAMBER BEING BUILT

carrying five sets of screens, each set consisting of four screens.

The water enters from the 54-in. concrete pipe at Elev. 252 through an easy bellmouth and, after being divided by a concrete cut-water opposite, flows two ways through two 42-in. square sluice gates. It then expands immediately in section, flowing into a gradually narrowing annular section between the inside wall of the large shaft and the exterior wall of the inside shaft; the latter formed by the screen piers and the screens themselves. This interior shaft is located eccentrically within the larger shaft, thus narrowing the channels of flow from about 48 to 18 in. in width.

At each of the five openings, there are two 2½x8-ft. wire screens installed in duplicate, thereby allowing one screen to remain in place while the other is being cleaned. The screens in each opening are located one above the other and extend from the legal low water or Elev. 262.5 to Elev. 242. At the bottom of each screen



INTAKE SHAFT, SCREEN AND GATE HOUSE

is a small trough which catches dead fish and other debris when the screen is raised. Each screen slides in a separate groove and will be raised by lowering a carriage from a small crane overhead which automatically couples onto the screen. The flow of water through these screens will be only 0.5 ft. per sec. with a flow of 50 m.g.d., while at the present the velocity is 3 ft. per sec. with a flow of 16 m.g.d. We feel that this will stop the small fish from being drawn against the screens and thus eliminate this trouble.

On the intake side of the shaft is a smaller circular

From Job and Office

For Contractor and Engineer

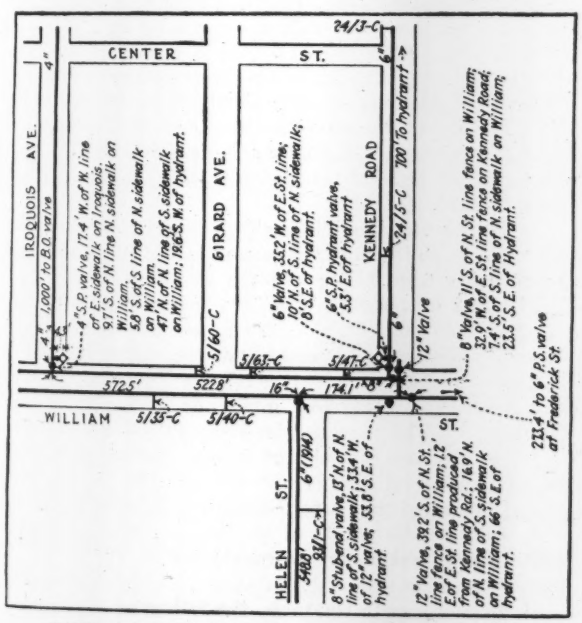
chamber which contains a 48-in. gate. The walls of this chamber extend down to ledge, and on that as well as the larger shaft are supported the beams which carry the screen house superstructure, a 21x28-ft. brick building.

The accompanying view shows the construction of the larger shaft and gate chamber before the inner shaft and floor were poured. The rectangular walls, 5 ft. deep, carry the walls of the brick superstructure. The line drawing shows typical sections of the intake shaft and screens. The work is being done by the Foundation Co. of New York. Metcalf & Eddy of Boston are the consulting engineers.

Co-ordinating Water-Works Records

By H. F. Huy
General Manager, Western New York Water Co., Buffalo, N. Y.

TO INSURE correct and comprehensive records of its property the Western New York Water Co. has prepared (1) a general plan or main index sheet of its territory and (2) detailed plans of its pipe distribution system, the latter on a scale of 100 ft. to the inch. The detail sheets are so arranged that any number of them can be pasted together, making a larger map of certain sections, as no part of either plan overlaps the work shown on another plan. There is a light line along the border for cutting and fitting the adjacent plan. The general index plan and the detailed sheets are 24x34 in. over all. The detailed sheets are



PART OF DETAILED RECORD PLAN OF PIPE DISTRIBUTING SYSTEM OF WESTERN NEW YORK WATER CO.

numbered on a uniform system for ease in designating additional detail sheets and their location on the index map.

WESTERN NEW YORK WATER COMPANY
BUFFALO DIVISION
PLANT INVENTORY
Date Sept. 1, 1924

Subdivision: Town of Cheektowaga — Serial No. 102-1
Location: William St.
From: West Next Line Plate 102 — To: East Line Plate 102

ITEMS			REMARKS
Pipe:	863.6 ft. of 16 inch pipe on South side of street		
	51.0 " " 12 " " " Across " " "		Cross-Connection at Kennedy Rd.
	3022.7 " " 8 " " " North " " "		Incl. 16' for 8" Stub at Kennedy Rd.
	69.2 " " 6 " " " Across " " "		Incl. 62.0 for Stub connection at Glidden St. & 7.2 for Hydrant Branch
Specials:	1-16"×16"×12" Tee for Cross Connection at Kennedy Rd.		2-8"×8"×6" Tees
	1-16"×16"×8" Tee for 8" Stub End at Kennedy Rd.		4-12"×16" Reducers
	1-12"×12"×8" Tee for Cross Connection at Kennedy Rd.		
Curb Cocks and Curb Boxes:	31 - ½ inch	1 inch	
	2 "	"	
Corporation Cocks and Goose Necks:	½ "	2 - 1 "	(No Goosenecks - used for Pitometer Sta. #22)
	2 "	31 - 1½ "	
Meters:	28 - ¾ "	3 - ¾ "	
	1 "	"	
Meter Boxes:	22		
Fire Hydrants:	1 6 "	4 "	
Fire Hydrant Valves & Boxes:	None 6 "	4 "	
Line Valves:	1-16"		
	3-12" 4-8"		16"-125# 12"-82.1# 8"-47.9#
	1-6" Stub for Glidden St.		
Pipe:	Kind C.I. Condition Good	Laid 16"-1907, 8"-1902	Weight Per Ft. 6"-33.3 lbs.
Paving:	Laid 1922 Kind Concrete	Class of excavation Earth	
	Paid for by Municipality	72 Cu.Yds. of Rock	
Covering over pipe, approximately	4 feet.		
Average length of services, "	31 "		
Total number of houses	33 Supplied by W.N.Y.W.Co.	31	
Source of supply of	2 houses not connected Wells		

Note.- Specials at Street Intersections are arbitrarily shown with the North & South Street.
Example: 8"×6" Cross at Harlem Ave. & William St. is listed on Sheet for Harlem Ave.

For Field Notes see. Main Book #27 Valves Book #27 Hydrants Book #27

Approved: H. F. Huy (General Manager) Signed: Jos. L. Shed (Foreman)

FOR REMARKS USE OTHER SIDE

WATER-WORKS PLANT INVENTORY RECORD SHEET
The original sheets are 9x14 in., and include a margin of 1 in. at the left, punched for loose-leaf filing, not shown in reproduction.

The pipe lines, valves, hydrants, etc., are carefully referenced by actual survey on the ground, in many cases involving a wireless pipe location survey. (See portion of one of the detailed maps reproduced herewith.) The pipe line and appurtenances are referenced carefully as to existing structures on the surface so as to be relocated when necessary.

Every consumer connected to the system of the company has been located on the various streets and the service connection marked by an index number. Thus, in 44/7 — C, 44 is the street number, 7 the house connection number and C the district, which includes several of the areas indicated by the detailed maps numbers. The combination corresponds to the water register account and there is an envelope folder in a vertical file system containing all the history, complaints, tapping records, meter removals and repairs to this particular service from the time of its original construction. Many of the consumers are people with names that are hard to write—composed of a number of consonants—and harder to understand when given to the clerks in the office. The account is more easily traceable and the record more easily kept by the number system.

The streets are indexed in an index file under numbers rather than names, for the reason that sometimes in a large territory covered by the company there may be streets of nearly the same name. It also makes the fly-leaf smaller, which projects beyond the face of the loose-leaf in the register in which the accounts are kept. We find this arrangement of numbering accounts advantageous because of its simplicity and also because it shows quickly the approximate ratio of house connections on a given street, as the highest number is always the last house connected.

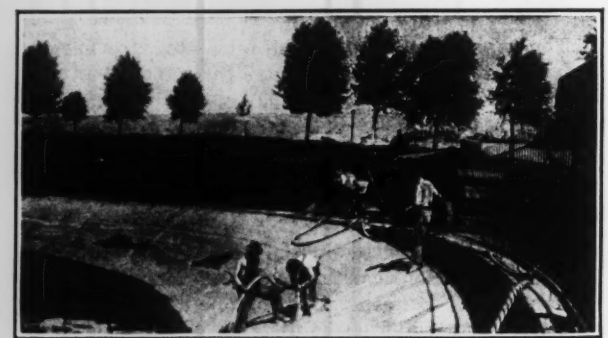
In the lower left-hand corner of the detail plan the engineers record the latest revision of the map, the services being located during the year that they are installed and placed on the plans.

These detail plans are also arranged to facilitate the preparation of an inventory of the property and kept up to date very simply by having an inventory sheet (reproduced herewith) in a folder having the same number as the plan. On this inventory sheet are recorded the plan number and amount of piping on the street on that particular plan. The summary of each sheet is prepared and referred only to that particular map, so at any time it can be revised and records kept up to date or checked by any other engineer making a value inventory of the plant. These sheets are kept in folders having the same number as the plan, in a vertical file system, the object of the entire map system being to tie it up with the physical plant, so as to be kept up to date in unison with the accounting system, inventory value of the plant and records in reference to all locations of the work done in connection with the property.

Cracks in Reservoir Tower and Wall Repaired with Cement Gun

By Eugene Carroll
Vice-President and Manager, Butte Water Co., Butte, Mont.

UPON EMPTYING, in order to clean, the South Fork Reservoir of the Butte Water Co. (a 13-m.g. reservoir formed by a 30-ft. concrete-core earth dam), we



MENDING CRACKS IN RESERVOIR SLOPE LINING

found the intake chamber, which is built of concrete, cracked completely around the circumference at a distance of about 20 ft. below the high-water mark. The cause of this crack was probably ice pressure.

The easiest way to repair this crack was to use a cement gun. After opening the crack to give a good surface to work on, we injected a 4 to 1 cement and sand mortar into the crack from a cement gun located on top of the dam, operated with a portable air compressor. The repairs were made in less than four hours after the erection of the scaffold and the placing of the cement gun.

The work was so successful that we moved the gun and outfit to our West Side reservoir and repaired its lining, which had been broken and loosened by ice. The views show the method of applying the cement for patching the lining.

CIRCUMFERENTIAL CRACK IN CONCRETE INTAKE TOWER REPAIRED WITH CEMENT GUN

Not including equipment, the cost of the repairs was less than 25 per cent of what it would have been had the work been done by hand, and from all appearances it will be much more satisfactory, as by placing the plaster under pressure a much better bond is made with the concrete than is possible in hand work.

From Job and Office

Hints that Cut Cost and Time

Computing Head Loss in Gridiron Distribution System

By W. S. Pardoe
Professor of Hydraulic Engineering, University of Pennsylvania, Philadelphia

THE ACCOMPANYING plan of a section of a city shows a tentative gridiron system supplied at *gGg'* with a prezometric elevation of 114. The plan shows distribution districts 3 to 6 inclusive with fire and domestic demands in each. The most critical point, i.e., the most distant, is at point *A* where the ground elevation is 15 and the pressure at times of greatest fire draught is to be 25 lb. per square inch (57.5 ft.): hence the prezometric elevation is 72.5. There is, therefore, 41.5 ft. to lose.

In laying out the trial system all of the water was assumed to go through the large pipes, 10 in. and above, there being 6 in. filling in pipes on all streets.

The loss of head from *gGg'* to *A* is now computed. If it is less than 41.5 ft. the larger pipes may be reduced sufficiently to make up the difference. The method consists of substituting for the gridiron system a series of equivalent pipes and finding the loss of head in it. The various steps are as follows:

1. Divide lines *g'a'* and *ga* in any convenient number of parts (6 used here); join *bb'*, *cc'*, etc. These lines might be called pressure contours.

2. Join middle points of *aa'*, *bb'*, *cc'*, etc., giving line *ABCDEFG*, which may be considered as the line of the equivalent pipe.

Referring now to the table, the following explanations are made.

Column 1: is the portion of the system being computed; *bb'* to *cc'* is used in the example.

Column 2: The number and size of pipes. The number is not a whole number if the pipe goes only part of the distance from *bb'* to *cc'* or there may be

From Job and Office

For Contractor and Engineer

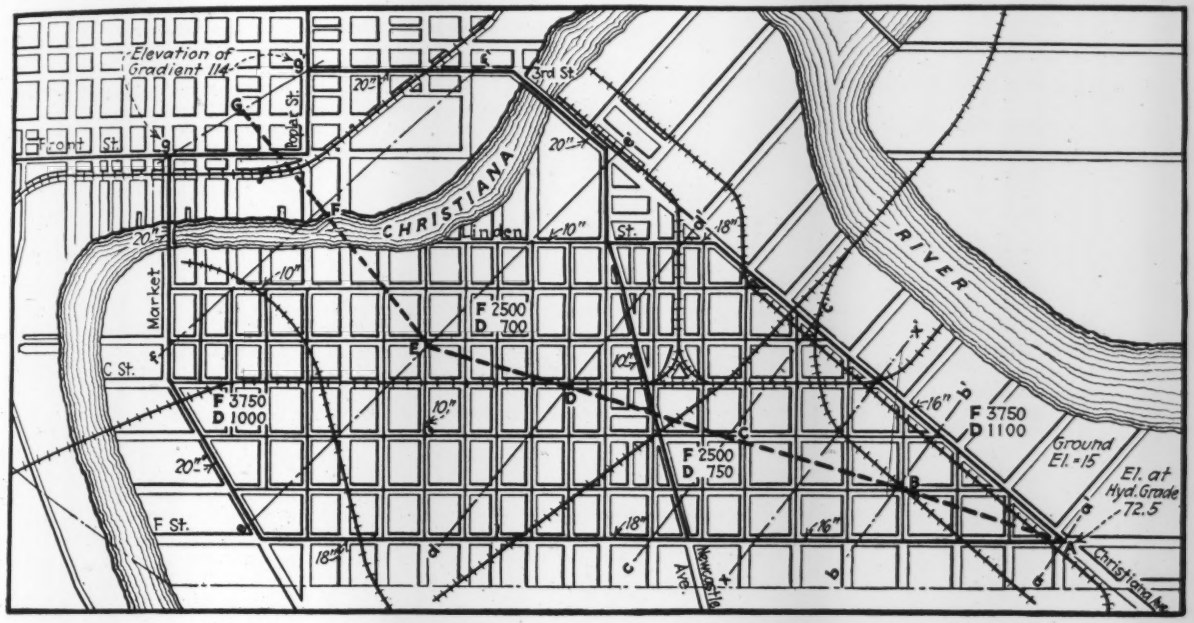
more than one similar pipe as in the case of the 6-in. pipes.

Column 3: The length of the pipe from contour to contour measured on the line of the pipe although it may not go all the way across.

Column 4: The loss of head per 1,000 ft. on the equivalent pipe $\left(\frac{2}{L}\,1{,}000\right)$. It is at this point the assumption of 2 ft. lost head cancels out.

Column 9: The diameter of the equivalent pipe obtained from the total of col. 6 and col. 8. It is 21.7 in., an odd size and would have been the same no matter what the lost head assumed in col. 4. This section of pipe *BC* is equivalent to all the pipes lying between *bb'* and *cc'*.

Column 10: The actual amount of water which must pass through this section at times of fire is equal to 3,750 g.p.m. for fire purposes and the domestic demand



TENTATIVE PLAN FOR GRIDIRON DISTRIBUTION SYSTEM IN A SECTION OF A CITY

assumed fall of 2 ft. (any other assumed fall within reason will give the same result).

Column 5: The discharge in gallons per minute on the foregoing loss of head per 1,000 ft. Obtain from Flamant's formula $V = 76.28\,d^{\frac{2}{3}}s^{\frac{1}{2}}$.

for the area lying to the right of line *xx'* (a mean line).

Column 11: The actual loss of head per 1,000 ft. is obtained from the diameter of the equivalent pipe and the total discharge as given in col. 10.

Column 12: The actual loss from *bb'* to *cc'* is ob-

COMPUTATION OF LOSS OF HEAD IN GRIDIRON SYSTEM OF ASSUMED SIZE

1	2	3	4	5	6	7	8	9	10	11	12
Contour to Contour	Number and Size of Pipes	Length of Pipe Between Contours L	Loss of Head per 1,000′ on Assumed Fall 2′	G.p.m. Discharge on Assumed Fall, One Pipe	G.p.m. Discharge All Pipes and Total	Length of Equivalent Pipe L	Loss of Head per 1,000′ in Equivalent Pipe $\frac{2}{L}\,1{,}000$	Diameter of Equivalent Pipe Cols. 6 & 8	Actual Discharge for Districts Lying Beyond Mean Line of Contour	Actual Loss of Head per 1,000′ from Cols. 9 & 10	Actual Loss of Head from Contour to Contour Cols. 7 & 11
b—b′ to c—c′	1 —16″	1460	1.37	1370	1370				½ (6) .366		
	1 —16″	1783	1.12	1220	1220				½ (5) 150		
	2½— 6″	1783	1.12	85	212	1540	1.30	21.7″	Fire 3750	2.34	3.60
	2½— 6″	2400	0.83	75	161				4266		
	1 —10″	1800	1.11	338	56						
				Total	3019						

Column 6: The product of the discharge per pipe and the number of pipes from columns 2 and 5 and the total gallons per minute.

Column 7: The length of the equivalent pipe *CB*. This need not be measured accurately as a small error in the length of this pipe, resulting from the computation, will cancel out.

Column 8: The loss of head per 1,000 ft. in the

tained from col. 11 and col. 7 expressed in thousands of feet.

The lost head in each of the other five sections is obtained in a similar manner and a total of 32.1 ft. obtained. Obviously, the system is too large and some of the larger mains are reduced 2 in. in diameter and the altered system is re-checked and altered until the loss approximates 41.5 ft.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Air Currents and Ventilation in the Liberty Tunnels

Sir—The result of observations of the U. S. Bureau of Mines and the county officials covering six months natural ventilation of the Liberty Tunnels at Pittsburgh, Pa., published in your issue of Aug. 21, p. 290, is a notable help to those working on the ventilation of vehicular tunnels. These records of natural ventilation with and without traffic prove conclusively that cars and motor trucks while moving at allowable speeds induce air currents along the roadway from the entrance portal to the exit more than sufficient for the proper dilution of carbon monoxide, even against an adverse wind at the exit portal. The happenings described also show that forced ventilation is requisite when the traffic slows down or stops. The report describes the ventilation system which is provided for use when needed, consisting of a shaft for each tunnel midway between portals that is divided into four flues, through the outside ones of which blowers force fresh air obliquely into the roadways by means of side ducts about 50 ft. long, while exhaust blowers draw air from the two middle air ducts, which connect with top of roadway. The fresh air supply, as in the ordinary nozzle method, produces a current towards the exit portal which in turn induces one through the entrance portal and thus ventilates the whole roadway during the stoppage of traffic. The exhaust blowers are used to remove smoke and draw in fresh air from the portals. In a recent fire they did this effectively.

As brought out in the report, a blockade in one of the tunnels resulted from an interruption of traffic some distance away on the outside, before the ventilation plant was in working order. Enough cars kept their motors idling or racing to charge the air with carbon monoxide in excessive quantities, so that a number of people were overcome. Some abandoned their cars, leaving the engines racing, and a number escaped through the cross passages into adjoining tube where they found the air in excellent condition, from traffic going in the other direction. This shows that even an ordinary stoppage of cars may require forced ventilation and proves the need of frequent connections to an adjoining tube for immediate use when lives are at stake.

I believe that the Pittsburgh experiences demonstrate the controlling importance of longitudinal ventilation or *roadway ventilation*, as I prefer to call it, in which the roadway itself is the only or at least the principal ventilation duct. We can no longer question the fact that whenever traffic moves in a tunnel it produces a strong movement of air with the traffic, and that this air current is adequate to assure the desired degree of purity of tunnel atmosphere even for fairly long tunnels. This natural roadway ventilation will exist, and *will control the air movement in the tunnel*, regardless of supply and exhaust in transverse direction. It therefore seems to me that the arrangement of tunnel ventilation should logically be built up on the basis of roadway ventilation.

Confirmation of this view has been found in the detail calculations made by the writer in connection with the design of a ventilation plant for a subaqueous vehicular tunnel shortly to be built. In this design the facts brought out in the Liberty Tunnel experience are applied, namely: (1) that cars at regular speed can be depended upon to dilute their own carbon monoxide by the air current which they induce, and (2) that a blower plant in reserve needs to be provided for use when traffic is stopped. Ventilators on the stacks are provided to be used instead of blowers when traffic is light and some wind is available. which can be used exclusively for forced ventilation if the wind is strong enough. An air duct is provided under the roadway through which plenum blowers force fresh air at low speed into the tunnel midway between shafts through gratings of suitable area. Exhaust blowers draw the impure air directly from the tunnel at the shafts in such quantities as to take out air forced in by the plenum blowers between shafts and to draw in through the portals the fresh air required between shafts and portals. The provision of frequent connections between adjoining tubes for immediate escape in emergencies, without breathing dangerous air, is a *sine qua non*.

The air currents produced in the roadway by blowers have less velocity than the air currents induced by traffic in the Liberty Tunnels. This fact has added significance when the 468 sq.ft. of cross-section of the Liberty Tunnels is considered, together with their length of over a mile between supply and exhaust, as the air comes in through one portal and goes out through the other. This certainly justifies the system described above, which takes advantage of the large area of the roadway for exhaust with consequent low velocities and low static pressure at the blowers.

It is only just to say that those who planned and constructed the Liberty Tunnels, and then observed with skill and thoroughness the practical results obtained in their use, have taken vehicular tunnels beyond the experimental and speculative stage and have furnished the world with facts that are bound to prove fundamental in future planning of highway tunnels.

JOHN F. O'ROURKE,
Consulting Engineer.

New York, Sept. 20, 1924.

A Lumber Dealer Protests

Sir—Your edition of Sept. 4 carries an article under the head of "Thin Lumber and Honesty" that proves the theory of evolution, as the man who wrote it must be only a few jumps ahead of the monkey family; he is laboring under plain ignorance of facts and practices existing in the lumber trade.

At the present hardwood logs are sawn in this territory green to 1$\frac{1}{16}$ in. thick to allow for shrinkage in drying. The saw wastes $\frac{3}{32}$ to $\frac{1}{8}$ in. in sawdust, and thus the sawmillman uses up as high as 1$\frac{1}{8}$ in. thickness of the log to furnish a 1-in. board that he guarantees, when it is further millworked by surfacing two sides, will hold to 1$\frac{1}{8}$ net thickness. This latter thickness is amply strong enough for practically all purposes it is put to. To cut lumber thicker is an absolute waste of our national supply of timber.

All thicknesses of lumber from 1 in. down are sold surface measure; one thousand feet of $\frac{5}{16}$-in. cigarbox lumber will cover as great a space as one thousand feet of $\frac{13}{16}$-in. sheathing lumber ($\frac{3}{4}$-in. sheathing is plenty strong enough for the purpose). The price on the thinner thickness is less than standard inch in direct proportion to the thickness and waste of kerf and shavings and millwork required to make it.

We are now furnishing some S2S cypress that must be full 1-in. after surfacing on the planer. For this we get a premium of about $20 over the price we would get for regular 4/4 S2S. Each time a man demands thicker than regular he is liable to be wasting his own money and reducing the timber supply of his fellow citizens. One who insinuates that those who are honestly trying to save this waste are dishonest only exposes his own ignorance and business sense. The American people have always been prodigal in the use or rather the waste of lumber, and it is time they woke up or they will find themselves short of supply and paying top prices for their wood goods.

Twenty years ago logs at river markets in rafts brought $6, but now the same logs will bring $30. The waste in saw kerf and shavings was bad enough then, but it is many times worse now. In car lots we get, f.o.b. Columbus, $35 for yellow pine joists S2S to 1$\frac{5}{8}$, while in Cleveland we get for the same items $37, because they demand them net 1$\frac{5}{8}$ in. thick. The extra freight and timber is charged for.

Lumbermen are as honest and patriotic and intelligent as any other class of men but have more conceited ignorance to battle with than most other men.

J. W. TAYLOR,
J. W. Taylor & Co., General Forest Products.

Columbus, Ohio, Sept. 20, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Weymouth Resigns From Reclamation Bureau

Chief Engineer Entered Government Service 22 Years Ago—Will Enter Private Work

Washington Correspondence

After more than twenty years of service in connection with Federal reclamation work, F. E. Weymouth, the chief engineer of the Bureau of Reclamation, has resigned to enter private employment. By so doing he has been able to double his salary. Mr. Weymouth's resignation becomes effective Oct. 31.

Some two months ago it was rumored that the Secretary of the Interior was about to request Mr. Weymouth's resignation as the result of discoveries made by the post office inspectors, who have been engaged in doing detective work in the Bureau. It can be stated positively, however, that Secretary Work had no hand in Mr. Weymouth's retirement. It is understood that he had determined that sufficient cause did not exist to justify a request for Mr. Weymouth's resignation. While this incident may have influenced Mr. Weymouth to cast about for private employment, it is known that the offer which resulted in his retirement from the Federal service did not materialize until last week.

Official Statement Issued

The official statement covering Mr. Weymouth's resignation, issued by the Department of the Interior, reads, in part, as follows:

"Mr. Weymouth has been induced to accept private employment at a greater salary, which is understood to be double what the government paid him. His long connection with the Federal reclamation work in responsible positions and wide acquaintance in the West will cause much regret at his departure.

"Mr. Weymouth was born in Medford, Maine, June 2, 1874, and graduated from the university of that state in 1896 with the degree of bachelor in civil engineering. Three years later his alma mater conferred upon him the full degree of civil engineer. Ever since he has been in engineering work, for the first ten years in a variety of connections—city work in Massachusetts, waterworks in Canada, canal surveys in Nicaragua, and railroad work in South America, but his professional work has been mainly with the Bureau of Reclamation and demonstrates that there are at times in the civil service opportunities for a career of distinction.

"Six months after the Reclamation Act was passed in 1902 Mr. Weymouth was engaged by the Reclamation Service and assigned to surveys in the West, mapping reservoir sites, canal routes, and irrigable lands. When the Service began construction work he was assigned to that and built dams, canals, and other works in the northwestern states. One promotion after another followed. One of his most notable achievements was the Arrowrock Dam in Idaho which was built under his supervision with a saving under the estimate of a year in time and a million dollars in cost.

"From the position of supervising engineer in charge of work in Idaho and vicinity Mr. Weymouth was called to Denver, Colorado, in 1916 as chief of construction for all the reclamation work. In 1920 he was made chief engineer."

Milwaukee Engineers' Society Celebrates Anniversary

The Engineers' Society of Milwaukee celebrated its twentieth anniversary by a meeting on Sept. 17, with seven of its past-presidents reviewing the past work and suggesting future activities. Organized originally for the local mechanical engineers, it later took in all branches and has now about 350 active members besides 750 who are affiliated members by reason of their membership in the local sections of the national societies.

In recent years the society has been active in civic affairs and has had special committees and reports on the Milwaukee River improvement, the harbor work and the street traffic and parking problem. It has assisted also in the collection of an engineering library at the public library. Other activities in which the society may render public service were outlined by the president, F. H. Dorner.

Philadelphia Bridge Approach Contract Awarded

At the meeting of the Delaware River Bridge Joint Commission on Sept. 19, Contract No. 19 for construction of the Philadelphia approach was awarded to Mazzolo & Marano, Philadelphia. The work covers the construction of the concrete and granite masonry of the approach structure from Fourth to Fifth Sts., the construction of steelwork for the footwalks, and the rebuilding of Fourth St. and other streets to provide for passing Fourth St. beneath the bridge approach. The street is graded down to the extent of nearly 10 ft.

Mazzolo & Marano were low bidders for the work. Six bids were submitted, for total amounts as follows:

Mazzolo & Marano, $401,238.50; Francis J. Boas, $429,010; Fred'k Snare Corporation, $434,683; Fish, Rutherford, Inc., $483,217.50; Underpinning and Foundation Co., $486,631; and Rodgers and Hagerty, $634,422.

State Highway Officials' Program Out Soon

Authors of Papers To Be Read at San Francisco, Nov. 17-20 Are Men of National Prominence

The program which will be presented at the annual meeting of the American Association of State Highway Officials to be held in San Francisco, Nov. 17-20, is being whipped into final shape. "How Shall Interstate Highways be Named and Marked" is the subject of a paper to be presented by A. H. Hinkle, the chairman of the association's committee on highway traffic and safety. The discussion will be led by W. G. Sloan, the state highway engineer for New Jersey. Other papers to be presented include the following:

"Urgent Needs for Uniform Traffic Laws and Public Safety Devices throughout the United States," by Thomas H. MacDonald, chief of the Bureau of Public Roads.

"To What Extent May a State Economically Issue Bonds for Road Construction," by Frank T. Sheets, chief engineer of the Illinois Highway Commission. The discussion will be led by Frank Page, chairman of the North Carolina State Highway Commission.

"Highway Transportation Surveys," by J. Gordon McKay, chief of the division of highway transport and economics of the Bureau of Public Roads. The discussion will be led by W. H. Connell, the engineering executive of the Pennsylvania State Highway Department.

"Problems of Mountain Road Construction," by James Allen, Washington State Highway Engineer. The discussion will be led by L. I. Hewes, the deputy chief engineer of the Bureau of Public Roads.

"The Value of the Practice of Weighing Concrete Aggregate for Pavement Construction," by R. W. Crum, engineer of materials for Iowa. F. C. Lang of Minnesota will be in charge of the discussion.

"Some of the Recent Conclusions in Highway Research," by A. T. Goldbeck, chief of the Division of Tests of the Bureau of Public Roads. Charles M. Upham, the state highway engineer for North Carolina, will lead the discussion.

"Needed State and National Highway Legislation for the Public Land States," by Harvey M. Toy, chairman of the California State Highway Commission. The discussion will be led by C. S. Avery, chief of the State Highway Commission of Oklahoma.

"Some Interesting Features in the Construction of the Wendover Cut-Off in Utah," by Howard C. Means, chief engineer, Utah Highway Commission.

"Convict Labor in Highway Construction," by R. M. Morton, state highway engineer for California. The discussion will be led by O. T. Ready of Colorado.

Science Observes Franklin Institute Centenary

Distinguished Men of Two Continents Gather at Philadelphia for Three-Day Session

Engineering News-Record Staff Report

With an attendance of distinguished scientists and engineers from Europe as well as from the United States and Canada, the Franklin Institute, Philadelphia, celebrated the centenary of its foundation by a three-day meeting last week. Nearly fifty papers on engineering and scientific subjects were presented at group sessions while the entire attendance was brought together in three general meetings.

The distinguished character of the gatherings can be judged from the names of some of those who presented papers: Sir Ernest Rutherford, of Cambridge University, and Sir William Henry Bragg, of the Royal Institution, the distinguished British physicists; Prof. Charles Fabry, of the University of Paris, the spectroscopist; Dr. F. Haber, of Berlin, inventor of the Haber process of nitrogen fixation; Sir Charles Parsons, of steam-turbine fame, while among our own eminent scientists were Langmuir, the physicist, Dr. Coolidge, who has done so much for the development of X-ray and radio tubes, Prof. A. A. Michelson, who has measured the diameter of the stars and is now making a new determination of the velocity of light, and Elihu Thomson, dean of research men in the United States. Some 800 men and women were in attendance, many of them being the designated representatives of universities and learned societies in every part of the world.

Engineering Papers Presented

Various phases of study of the constitution of matter were covered by numerous papers, including those by Sir Ernest Rutherford, Sir William Henry Bragg, and Dr. Langmuir, by Dr. Mendenhall, of the University of Wisconsin; Prof. J. S. E. Townsend, of the University of Oxford; Dr. Pieter Zeeman, of the University of Amsterdam, and Prof. William L. Bragg, of Victoria University. Aeronautics, military engineering and metallurgy were also covered in groups of papers. In strictly engineering lines, aside from military engineering matters, there were papers on "The Progress and Promise of Engineering," by Dean Dexter S. Kimball, of Cornell University; "Effect of Loading Granular Material," by Daniel E. Moran; "Progress in Telephony," by Gen. John J. Carty; "Unusual Problems in the Design and Construction of Large Bridges," by Ralph Modjeski; "Steam Turbines," by Sir Charles Parsons; "The Mercury Boiler," by William L. Emmet; and on "Twenty-Five Years' Progress in Explosives," by Dr. Charles L. Reese.

Among the addresses of a general character were papers on "The Fifth Estate," being an estimate of the position of the scientist in the modern world), by Arthur D. Little, of Boston; on "The Field of Research in Industrial Institutions," by E. W. Rice, Jr., honorary chairman of the General Electric Co., and a very brief but thought-provoking address by Dr. F. Haber at the centenary banquet.

Illustrating the influence of industrial research in modern life, Mr. Rice, in his paper on research in industrial institutions, pointed out that in one company in which a survey was made recently it was found that no less than 15,000 men were employed in making products which had been developed in the research laboratory and that the value of these products was $60,000,000 per year. He stated also that if the present candlepower of incandescent lamps were produced by carbon filament lamps, instead of the present-day mazda type, the current bill of the country would be increased by $1,000,000,000 per year.

Professor Michelson gave the preliminary results of a new determination of the velocity of light. These results, he believes, are accurate within one part in 10,000, but, with certain improvements in the apparatus, he expects next year to secure a very much greater accuracy and to determine the velocity of light within one mile per second.

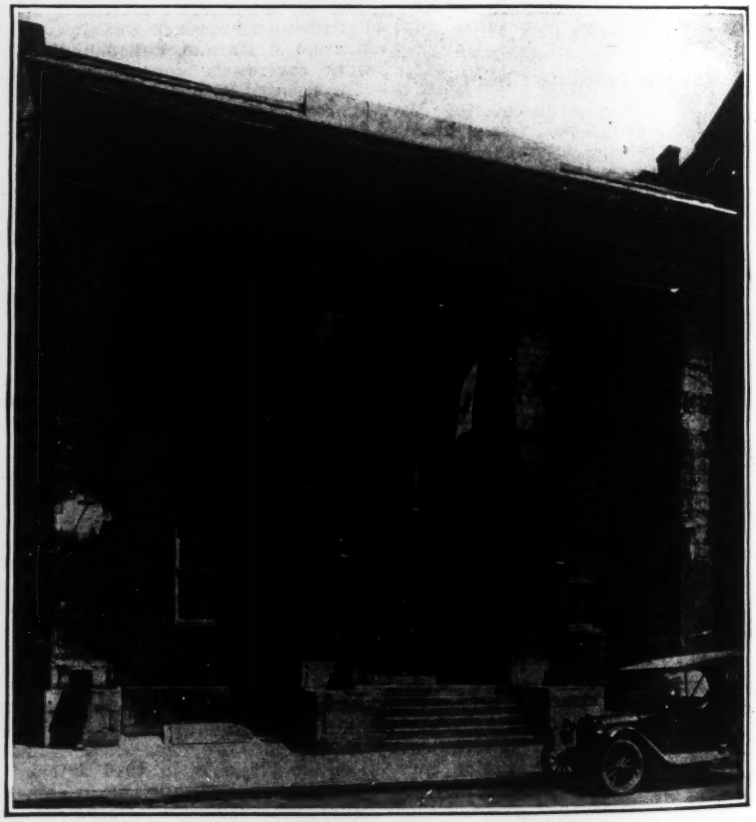
The concluding ceremony of the celebration was a gala banquet, at which the delegates from universities and learned societies presented their congratulations to the Franklin Institute.

* * * *

Franklin Institute was founded in 1824 under the inspiration of two young Philadelphians, Samuel V. Merrick, and Prof. William H. Keating of the University of Pennsylvania. The objects as given in its charter, granted that year, were: "The promotion and encouragement of manufacturers and the mechanic and useful arts, by the establishment of popular lectures on the sciences connected with them, by the formation of a cabinet of models and minerals, and a library, by offering premiums on all objects deemed worthy of encouragement, by examining all new inventions submitted to them, and by such other measures as they may judge expedient."

Under this charter the Institute has had a steady growth in membership and prestige, there being now 1,300 members. From the beginning distinguished scientists and engineers have presented the results of their work before the Institute and have had their results recognized through the award of the medals of the organization. Among recipients of its medals have been Thomas A. Edison, Guglielmo Marconi, Professor Michelson, Sir Charles Parsons, Sir Joseph Thomson, Frank J. Sprague, Ralph Modjeski, Gen. John J. Carty, Alfred Noble, Sir Robert A. Hadfield, Henri Moissan, Dr. Michael I. Pupin, Professor Roentgen, and Elihu Thomson.

Engineers have always played an important part in the management of the Institute. Among the presidents have been Coleman Sellers, William Sellers, and John Birkinbine. The president at the present time is also an engineer, Dr. William C. L. Eglin, vice-president and chief engineer of the Philadelphia Electric Co.



HOME OF FRANKLIN INSTITUTE IN PHILADELPHIA

Engineers Fete President of British Institution

Sir Charles Langbridge Morgan, president of the Institution of Civil Engineers, of London, England, who was the official delegate representing the institution at the centenary celebration of the Franklin Institute, held last week in Philadelphia, was the guest of honor at an informal luncheon in the Union League of Philadelphia, Sept. 19. Among those present were:

Guilleam Aertsen, past-president, Philadelphia Engineers Club; James H. M. Andrews, chief engineer, Philadelphia Rapid Transit Co.; Charles E. Billin, secretary, Engineers' Club; Richard G. Develin, assistant engineer bridges, Pennsylvania R.R.; Clark Dillenbeck, assistant chief engineer, Philadelphia and Reading Ry.; Henry E. Ehlers, director, Philadelphia Department of City Transit; Robert H. Fernald, past-president, Engineers' Club; Benjamin Franklin, consulting engineer; F. Lynwood Garrison, consulting engineer; Edward T. Grandlienard, acting director, Department of Civil Engineering, University of Pennsylvania; Charles Haydock, engineer, Waters Co., Pennsylvania R.R.; Richard L. Humphrey, consulting engineer; Robert W. Lesley, past-president, Portland Cement Association; John Meigs, consulting engineer; Walter Samans, chief engineer, Atlantic Refining Co.; Alexander C. Shand, chief engineer, Pennsylvania R.R.; Henry J. Sherman, consulting engineer, New Jersey Board of Commerce and Navigation; Charles H. Stevens, president, Philadelphia Section, Am. Soc. C. E.; S. M. Swaab, consulting engineer to the mayor of Philadelphia; Carroll R. Thompson, chief engineer, Department of Wharves, Docks and Ferries; John A. Vogelson, chief engineer and surveyor, Bureau of Surveys; Joseph C. Wagner, formerly assistant director, Department of Public Works; Samuel T. Wagner, chief engineer, Philadelphia and Reading Ry.; and George S. Webster, past-president, American Society of Civil Engineers.

Sir Charles Langbridge Morgan began his engineering career in June, 1870, on the Great Western Ry. In 1883 as chief assistant engineer of the Great Eastern Ry. he was in charge of the construction of the Liverpool station. From 1896 to 1917 he was chief engineer of the London, Brighton and South Coast Ry. Co. during which period the Victoria new station was constructed and many lines in and around London were widened.

Sir Charles was a lieutenant-colonel of Royal Engineers during the World War.

Road Signs Prohibited

To protect the traveling public, the use of posters or other commercial advertisements or signs within the limits of the roads or highways in the Province of Quebec has been prohibited by the minister of roads of the province. The only signs allowed are official danger and direction signs of the Roads Department; all other signs will be removed by the department.

Dean Cooley Unopposed

Dean Mortimer E. Cooley, candidate for U. S. Senator from Michigan, was unopposed at the recent Democratic primaries. He will run against Senator Couzens, the incumbent, a Republican. Thomas Maddock, former state engineer of Arizona, who was a candidate for governor, was eliminated in the primaries. Governor Hunt, who was a Democratic nominee for re-election, will be opposed at the polls by D. B. Heard, of Phoenix. The former is an avowed opponent of the Colorado River seven-state compact, while Mr. Heard favors it with reservations.

Special Boston Water Commission Appoints Engineers

The Metropolitan Water Supply Commission, created to investigate the water-supply needs of Boston and vicinity and Worcester, has appointed Allen Hazen, of New York City as engineer, Leonard Metcalf, of Boston, as consulting engineer, and Raymond C. Allen, an engineer of Manchester, Mass., secretary to the commission. The members of the commission, as stated in our issue of Sept. 11, p. 441, are Charles R. Gow of Boston, who is chairman, E. E. Lochridge, of Springfield, and George F. Booth of Worcester, the first two being engineers.

Complaint Issued Against "Chief Draftsman Dobe"

The Federal Trade Commission has issued a complaint charging unfair methods of competition against F. W. Dobe, of 1951 Lawrence Ave., Chicago, Ill., a correspondence teacher of mechanical drafting.

The complaint alleges that in order to secure pupils, the respondent has through his advertising material caused to be set forth numerous false and misleading statements to the effect that he is chief draftsman of the Engineers' Equipment Co. which employs a large force of mechanical draftsmen under his supervision, and that respondent will place pupils in positions at salaries of $250 or more per month. These statements and assertions, the complaint recites, cause many of the public to enroll as pupils of respondent under the mistaken belief that upon completion of the course they will be placed in lucrative positions. It is alleged, however, that respondent has been able to secure employment for only a small number of his pupils, and at salaries far below $250 per month.

The question whether such methods as have been used are unfair is not passed upon by the Commission finally until after respondent have had thirty days in which to answer and the issue has been tried.

An account of the activities of the American Association of Engineers against "Chief Draftsman Dobe" and his methods was contained in *Engineering News-Record*, March 29, 1923, p. 983. The Associated Advertising Clubs of the World also had opposed his methods.

New Reclamation Laws Under Discussion

Details of Proposed Bill Based On Recommendations of Special Advisers

Washington Correspondence

Reclamation legislation is to be taken up actively on the opening of Congress Dec. 1. The bill introduced at the last session provides only for a portion of the program recommended by the Committee of Special Advisers. The bill provides for basing annual payments on construction charges on the annual crop return; for investigation and report in cases where lack of soil fertility, scarcity of water or other causes makes it impossible for the settler to pay project costs; for the payment of operation and maintenance charges in advance; and for relieving the water users of the costs of general investigations and of the Washington office.

The difficulty with this legislation is that it covers only a portion of the recommendations, which in themselves do not create a workable plan. It does not provide for the development of new projects. There is certain to be an effort to amend the bill, particularly with regard to the disposition of private lands in excess of the farm unit. One essential of the situation is believed by many to be the elimination of land speculation and the reduction of tenantry. It was not the intention of the framers of the original act, it is contended, to subsidize private owners by furnishing them money without interest to develop large tracts and sell their excess holdings to settlers at inflated prices. The advisers recommended that no project be authorized until all privately-owned land in excess of the homestead unit should be acquired by the United States. It is very apparent that there will be a demand on the part of members of Congress from the East to adopt stringent safeguards against land speculation and to provide for a more careful selection of settlers.

Importance of Issue

The fact that this legislation is a part of the deficiency bill, which failed, makes it certain that it will be one of the first things considered at the forthcoming session. What has happened in connection with reclamation during the past year has tended to center attention on it, and it is expected fully that there will be discussion of the whole question.

It has become known that a bill will be introduced proposing to convert the Bureau of Reclamation into a government corporation. Others are of the opinion that it would be better to give this agency a status such as that enjoyed by the Federal Reserve Board or the Farm Loan Board. It is practically certain that some such change will be pressed, as there is a very general realization among the members of Congress that the Bureau of Reclamation as now constituted is a political institution. It has been the football of politics through several administrations. The belief is that it must be converted into an economic agency as one of the urgent essentials of improving the situation.

Holds to $99,000,000 Water Supply Project

Philadelphia Water Supply Commission Compares Six Projects But Sticks to First Plan

Called upon after a public hearing to make a more detailed report on an improved water supply for Philadelphia than the one submitted on May 22, the seven engineers composing the special water commission submitted a report on Sept. 13 in which it compares six projects, including the one which Fred C. Dunlap, formerly chief of the Bureau of Water, has been contending for. The commission sticks to its earlier recommendation for (a) storage reservoirs on Perkiomen and Tohickon Creeks, and (b) improvements to the Torresdale pumping and filtration plant on the Delaware River, the two sources providing a combined supply of 500 m.g.d. The earlier report of the commission, complete, was printed in our issue of June 5, p. 968, and contained references to still earlier issues outlining the Dunlap scheme and also the recommendations of a still earlier commission, the personnel of which was largely the same as that of the present body.

The commission states that although Delaware and Schuylkill water are at times about equal in bacterial content, the Delaware is free from pollution due to industrial wastes, which are the cause of frequent complaint in the case of the Schuylkill. The Delaware also has advantages in being generally lower in bacteria, of containing more dissolved oxygen, less organic matter and less turbidity. It is more uniform in quality than in the Schuylkill.

Water from any source would require filtration. It is estimated that Perkiomen-Tohickon-Neshaminy water in storage will be of about the quality of the water produced by passage through the first filters of the Torresdale intake supply from the Delaware.

The report states that partial metering has reduced the per capita consumption from 181 gallons in 1918 to 168 gal. in 1923. About 26 per cent of the services are now metered. It is estimated that a further reduction of 39 gal. per capita can be made by complete metering within the next ten years. With consumption reduced to 110 gal. per capita, the supply from the Perkiomen and Tohickon alone, without recourse to the Delaware, would serve the city until 1938, and this supply if augmented by the Neshaminy could serve for fifty years, when the population would be about 3,500,000.

The recommended plan is adaptable to deferred construction in the event that financing requirements should make that procedure desirable. The deferred items comprise the construction of two dams and basins, estimated at $6,000,000, the reduction of the filter capacity, $5,500,000, and shortening of the length of the pressure tunnel, $5,000,000. These three items make a total reduction of $16,500,000, leaving an estimated total of $75,000,000 that is essential for present construction.

The commission states that Project 6, for supply from the Blue Mountains, should be the ultimate aim of Philadelphia.

The relative merits of a Delaware River intake at Yardley (near Trenton, N. J.) recommended by Fred C. Dunlap, former chief of the Bureau of Water, and the one at Torresdale, continuance of which is recommended by the commission, are discussed at length. The commission believes that the double filtration at Torresdale secures better results than would be possible with single filtration at Yardley. They believe that as the sewage-works for the lower Delaware, already ordered and started, are carried out, conditions at Torresdale will improve and they consider that the benefits to be derived from the change of location of the intake are not commensurate with the cost.

COMPARISON OF SIX WATER SUPPLY PROJECTS FOR PHILADELPHIA

	Capacity M.G.D.	Cost Millions
1. The recommended project consisting of (a) Perkiomen and Tohickon Creeks, with pumping plant near head works, new filters, aqueduct new service reservoir near Roslyn Heights, and delivery through pressure tunnel to heart of city, at much higher pressures than are now given, and (b) continued use of Delaware River water at Torresdale, with renovation and enlargement of existing filters and pumping plant.	500	$91.5
2. Perkiomen, Tohickon and Neshaminy Creeks; like No. 1, except that Neshaminy water would replace the Delaware water from the Torresdale plant	430	116.1
3. Provides Perkiomen water for the present Schuylkill River filter plants; omits the pressure tunnel into the business district; delivers Tohickon and Neshaminy water to the Torresdale plant, in place of Delaware River water	430	90.7
4. Neshaminy supply with water pumped from the Delaware at Yardley, and delivered through a tunnel to Torresdale filters and Queen Lane pumping station for delivery to existing filters.	430	66
5. Susquehanna River supply from below McCall's Ferry, delivered through a pressure tunnel to the city, to be pumped and filtered at present plants after enlarging	500	245
6. Blue Mountain gravity supply from tributaries of Upper Lehigh and Upper Delaware, to be delivered to new filters and with facilities to provide increased pressure in the city	500	304

The estimates fro Projects 1 and 2 contain items for improved pressure and service facilities totalling $2,400,000, for which there is no equivalent in Projects 3, 4 and 5. The service to be secured by the high pressure could be provided by the other projects only after expensive increase of the distribution lines.

Further disapproval of the plan fostered by former chief Dunlap (Project No. 4) is expressed by the commission as follows:

"1. While as compared with recommended Project No. 1 its first investment is cheaper by some $25,000,000, the expense of pumping requirements more than offset its apparent saving in first cost.

"2. While it would eliminate pumping as now required at the Torresdale filter plant it would involve a continuance of equivalent pumping as now practised, together with additional pumping at Yardley to make up the difference between 170 m.g.d. yield from the Neshaminy watershed and the total consumption of the city.

"3. It does not adapt itself to the development of an upland or mountain supply except from the relatively low Neshaminy basin and therefore it does not fit in with what is bound to be the ultimate source of gravity supply for the city; that is, from the Blue Mountains. In fact, most of the investment would ultimately have to be scrapped.

"4. It is not susceptible of piecemeal construction as it could not be put into service, to replace Schuylkill River water, until a pressure tunnel 18 miles long had been built from the Neshaminy to Queen Lane, at an estimated cost of $38,000,000.

"5. It would afford none of the benefits incident to a pressure distribution tunnel as provided in Project No. 1.

"6. While the Delaware River water at Yardley is better than that now obtained from the Delaware River, it is not better than the water now delivered to the Torresdale slow sand filters. When the latter have been renovated, as it is necessary to do to take care of the health of the city during the period of construction of new works, then there is no substantial advantage in the Yardley supply. When the lower Delaware is cleaned up this statement will become increasingly true.

"7. Although Yardley is removed from the Lower Delaware it is nearer than Torresdale to the mouth of the Lehigh River with its prosperous growing industrial centers."

Discussing the means for securing Blue Mountain water as the ultimate source of supply, the Commission indicates three far reaching steps that have already been taken by some other cities, and that must be taken by Philadelphia: (1) Reduction of needless waste by metering. (2) Obtaining legislation whereby water-works bonds are exempted from the legal limit of bonded indebtedness or else formation of a Metropolitan Water District with financing arrangements independent of ordinary restrictions on city bond issues. (3) Fixing water rates so that consumers pay sufficient revenue to meet all costs of upland or mountain sources of water supply.

In addition to the expenditures for construction, the commission recommends the expenditure of $7,500,000 for improving the existing facilities, making the total cost of the recommended projects $99,000,000.

The Water Commission is composed of George H. Biles, director of public works, Solomon M. Swaab, consulting engineer to the city, Alexander Murdoch, chief of the Bureau of Water, Joseph F. Hasskarl, George W. Fuller, Allen Hazen, and J. Waldo Smith, the three last named of New York City.

Test Borings Made in Sacramento for Proposed Tidal Lock

Boring thus far near the mouth of the Sacramento and San Joaquin Rivers has revealed unexpectedly good foundation conditions for the proposed tidal lock which is being considered to prevent the entry of salt water into the lower stretches of the Sacramento, F. E. Weymouth, former chief engineer of the Bureau of Reclamation says. The work is being done in co-operation with the state of California and the Sacramento Valley Development Association. Mr. Weymouth is encouraged by the showing in the holes already drilled. If suitable foundations are available at the site now being bored. it will make the task of building the dam, which even at that point would be two-thirds of a mile long, much easier. He points out however, that there are other factors to be considered before deciding upon the feasibility of the project. One of the principal difficulties is to construct the dam so as not to add materially to the flood levels of the streams which are subject to very sudden rises.

Since more information is needed as to foundation conditions at the proposed hole-in-the-wall dam near Nyssa, Oregon, Mr. Weymouth ordered, before resigning his position as chief engineer (see p. 519), further borings made at that site.

Road Graded by Force Account

Maintenance forces of the Indiana State Highway Commission are building the grade for a 2.75-mile stretch of the Indianapolis Ave. road to the Illinois State line, where four Indiana roads and four Michigan roads use this entrance to Chicago. Bids were rejected as too high, but in order to have a portion of the pavement in use this year the commission decided to have the grading done by the maintenance division and to invite separate bids for paving, on Sept. 23. There will be two 30-ft. strips on opposite sides of an interurban railway, and it is intended to have the paving contractor complete one side of the work by December.

Civil Service Examinations

UNITED STATES

For the following civil service examinations apply to the U. S. Civil Service Commission, Washington, D. C., or to any local office of the commission.

Junior Aid, Grades 1 and 2 — Vacancies in the Bureau of Standards, Department of Commerce, at entrance salaries of $900 and $1,140, with possibility of increase to $1,260 and $1,500 respectively, the positions requiring one half-year of college work or experience in testing in a research laboratory and the work of the position being physics, chemistry, engineering and industrial technology.

Examinations for these positions will be given throughout the country on October 8.

Moffat Tunnel Progress

The heading crew working from the East portal of the Moffat tunnel through the Colorado Rockies made an advance of 1,404 ft. during the month of August. The advance was made partly in the pioneer or water tunnel and the rest in the main heading. The size of the two bores is 8 x 8 ft.

Personal Notes

WILLIAM J. BERGEN, SR., who since Feb. 1 has been chief engineer and valuation engineer of the Nickel Plate railroad system, has recently been made engineering assistant to the president of the system. Mr. Bergen has been with the Nickel Plate twenty-three years, starting in Cleveland as a division engineer.

THEODORE L. CONDRON and CHESTER L. POST, Chicago, Ill., announce the formation of the firm of Condron & Post, consulting and designing engineers, with offices at 53 W. Jackson Boulevard, to continue the engineering practice carried on by them since 1912 under the name of the Condron Co., and since 1901 by Mr. Condron.

CARLETON E. STONE and ARTHUR D. KEAGY, Pittsburgh, Pa., have formed a partnership under the firm name of Stone & Keagy and will conduct a practice in engineering, surveying and drafting in their office in the Benedum-Trees Building in that city. Mr. Stone is a registered professional engineer and surveyor, and Mr. Keagy is a registered professional engineer and was formerly with J. N. Chester, Engineers.

T. R. WELLS and H. W. DEAKMAN announce the formation of the Deakman-Wells Co., engineers and builders, with office at 921 Bergen Ave., Jersey City, N. J. Both men were formerly engineers in charge of the New Jersey office of the Hegeman-Harris Co., New York City.

HAROLD L. ROBINSON, civil engineer, announces that he is opening an office for the practice of civil engineering at 405 Main St., Worcester, Mass., to handle design of reinforced-concrete and other structures including bridges, and general and property surveys. Mr. Robinson graduated from the Massachusetts Institute of Technology in 1911.

MOHAMMED RIFAI, engineer in charge of roads and bridges of Egypt, has been in the United States for the past six months studying American methods of road construction and land drainage, and, in the West especially, has studied the drainage of alkali lands. It is reported that he was much interested recently in noting in Utah the use of tile in underdrainage and the employment of canvas dams for the diversion of water from head ditches to farm laterals, as shown to him by R. A. Hart, of Salt Lake City, drainage engineer, U. S. Department of Agriculture.

RAY S. GODARD, whose resignation as construction engineer for the Illinois Glass Co. was noted in this column June 26, will hereafter, be connected with the Consumers Gas Co., Ltd., Montreal.

CHARLES H. LOCHER of Hancock, Md., has accepted membership on the board of engineers to examine data on the Columbia Basin irrigation project in Washington.

F. T. HILLMAN, construction engineer for the North Dakota State Highway Commission, has resigned to join the Winston Brothers Co., of Minneapolis, on railway construction in Colombia, South America.

GEORGE H. WHITEFIELD of Montclair, N. J., has tendered his resignation, effective Sept. 30, as mechanical engineer in the Department of Institutions and Agencies, to accept the position of director of public utilities in Richmond, Va., his former home

J. J. MCCAW, city engineer of Nampa, Idaho, has resigned, and J. A. BERNEY, his assistant, has been appointed as his successor.

DR. S. S. CAMERON, the director of agriculture for Australia, was in Washington recently to confer with Dr. Elwood Mead in regard to reclamation matters.

A. F. DELIMA CAMPOS, engineer of the ministry of transport and public works of Brazil, is in the United States making a study of reclamation, and has visited nine of the federal projects.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 30 to Oct. 3.

AMERICAN CONSTRUCTION COUNCIL, New York City; Annual Meeting, New York City, Oct. 2-3, 1924.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, Detroit, Mich., Oct. 20-23, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Detroit, Mich., Oct. 23-25, 1924.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, San Francisco, Calif., Nov. 17-20, 1924.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Big Gain In American Machinery Exports

Recent Figures Show Market Still Increasing—1924 Year Should be Banner One

TOTAL United States exports of industrial machinery increased from $116,804,518 for the fiscal year ending June 30, 1923, to $133,623,733 for the fiscal year ending June 30, 1924, according to the Industrial Machinery Division of the Department of Commerce. The market for United States industrial machinery throughout the world is still increasing, according to these recent figures. Furthermore, the expansion is at a higher rate—14 per cent—than was indicated by machinery export figures for the calendar years 1922 and 1923 which increased 10 per cent.

Exports of power-generating machinery amounted to $14,854,032 for the fiscal year ending June, 1923, and $16,829,511 in 1924. The greatest increases within this classification occurred in the accessory groups: Steam engine accessories and parts increased nearly a million dollars and internal combustion engine accessories over $1,500,000. These gains more than offset declines in shipments of steam engines proper. Boiler shipments showed a gain of over $600,000 in the latter fiscal year.

Exports of construction and conveying machinery to world markets for the fiscal year ending June, 1924, increased over $2,000,000 above the preceding fiscal year. The greatest gains in this classification occurred in shipments of road rollers and dredging machinery.

Exports of mining, oil-well, and pumping machinery increased from $18,591,014 for the fiscal year ending June, 1923, to $24,661,900 for the fiscal year 1924, or approximately 33 per cent. Exports of oil-well drilling apparatus more than doubled in the latter year; steam pump exports increased approximately 47 per cent.

Architectural Terra Cotta

Bookings of architectural terra cotta by 26 identical manufacturers who produced about 95 per cent of the architectural terra cotta made in 1922, have been reported to the Department of Commerce for the past five years. The table shown below gives the tonnage and value since the beginning of 1919. Values exclude freight, cartage, duty and setting charges.

BOOKINGS OF ARCHITECTURAL TERRA COTTA

Year	Net Tonnage	Value
1919	63,024	$7,822,579
1920	67,543	10,742,841
1921	71,160	8,912,811
1922	126,288	13,952,916
1923	135,669	16,175,443
1924 (8 months)	97,908	10,713,937

Added Water Works Exhibitors

To the lists of exhibitors at the convention in Rochester, N. Y., next week of the New England Water Works Association, published in this journal, Sept. 4, p. 399, and Sept. 18, p. 483, the following final additions have been made, bringing the total number to 45:

Badger Meter Co.
A. P. Smith Mfg. Co.
Warren Foundry & Pipe Co.
Cement Lined Pipe Co.
Chapman Valve Mfg. Co.
S. E. T. Valve & Hydrant Co.
Leadite Co.
Birch Mfg. Co.

Cast-Iron Pipe and Fittings During 1923

The Department of Commerce announces that, according to reports for the biennial census of manufactures, 1923, the establishments engaged primarily in the manufacture of cast-iron pipe and fittings in that year reported such products valued at $87,443,039, together with other classes of products valued at $5,231,049, making a total of $92,674,088. The rate of increase in the total value of products as compared with 1921, the last preceding census year, was 109.1 per cent.

Of the 74 establishments reporting for 1923, 33 were located in Alabama, 9 each in New Jersey and Pennsylvania, and the remaining 23 in California, Colorado, Indiana, Maryland, New York, North Carolina, Ohio, Oregon, Tennessee, and Virginia.

The statistics for 1923 and 1921 are summarized in the table herewith. The figures for 1923 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

CAST IRON PIPE

	1923		1921		Per Cent of Increase, a
Number of establishments	74		70		
Wage earners (average number) b	21,576		12,496		72.7
Maximum month	July 22,560		Nov. 13,986		
Minimum month	Jan. 20,150		Jan. 10,183		
Per cent of maximum	89.3		72.8		
Wages	$25,019,953		$13,135,992		90.5
Paid for contract work	$7,403		$2,400		208.5
Cost of materials (including fuel and containers)	$48,804,425		$23,897,020		104.2
Products, total value	$92,674,088		$44,321,548		109.1
Cast-iron pipe and fittings	$87,443,039		$40,194,119		117.6
All other products	$5,231,049		$4,127,429		26.7
Value added by manufacture c	$43,869,663		$20,424,528		114.8
Horsepower	47,239		d		
Coal consumed (tons of 2,000 lb.)	170,497		d		

a Per cent not computed where base is less than 100.
b Not including salaried employees and proprietors and firm members. Statistics for these classes will be given in the final report.
c Value of products less cost of materials.
d Not reported.

Steel Fabricators to Meet

The annual convention of the American Institute of Steel Construction will be held at French Lick, Ind., November 13-15. Membership in the organization has been increased since the last meeting in Pittsburgh and now comprises 170 of the more prominent fabricators of structural steel in the United States and Canada. A standard code of practice has been prepared for adoption which, it is believed, will remove possibility of misunderstanding and establish contracts on a basis equally fair to architect, engineer, owner and fabricator.

Among the subjects to be emphasized at the forthcoming meeting will be the encouragement of better selling methods, in order that the advantages of structural steel may be understood and its use extended. It is planned to publish a sales manual, containing data which will further this movement. The coming convention will confine its attention to the principal problems of the industry, particularly those relating to service to mills, architects, engineers, contractors and the public.

Business Notes

UNITED STATES CAST IRON PIPE AND FOUNDRY CO. announces that the offices of its president, N. F. S. Russell, and its general sales manager, D. B. Stokes, formerly at Philadelphia, are now located at Burlington, N. J.

CUTLER - HAMMER MANUFACTURING CO., Milwaukee, Wis., announces the following changes in its organization: T. D. Montgomery, formerly manager of the eastern district, with headquarters in New York City, has been appointed assistant sales manager in charge of engineering sales with headquarters in Milwaukee. C. W. Yerger, formerly manager of the Boston office, will succeed Mr. Montgomery in New York; Mr. Yerger's position in the Boston office will be taken by J. M. Fernald. A. H. Fleet, formerly manager of the specialty department at Milwaukee will have charge of the sale of all merchandising products of the company. J. U. Heuser, formerly of the Chicago office, will be in charge of the recently established branch sales office in Milwaukee.

INGERSOLL-RAND CO., New York, has appointed L. G. Coleman, recently assistant general manager of the Boston & Maine R.R., manager of its locomotive department, newly organized to handle the oil-electric locomotive. W. L. Garrison, who has been in the engineering department of the company for a number of years has been made assistant manager.

FRANK A. WILCH, of the Triumph Electric Co., Cincinnati, Ohio, has been placed in charge of the Cleveland office and territory, succeeding Edward S. Ford.

Equipment and Materials

Chlorinator Has New Features

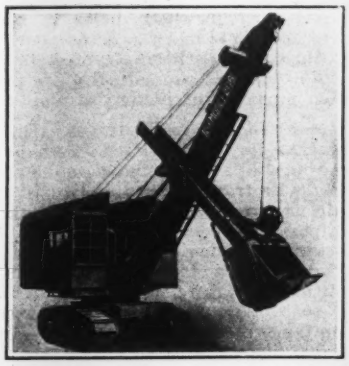
For the sterilization of water, sewage and swimming pools the Paradon Engineering Co., Long Island City, N. Y., has developed a simplified type chlorinator. New features include a removable chlorine inlet valve, in which the seat and stem are a unit and not detachable, thus eliminating the possibility of getting out of adjustment in the field. Flow of chlorine is regulated by the variation in tension on a diaphram which in turn is connected to the chlorine inlet valve. This makes the usual needle type of control valve unnecessary.

Both the inner and outer manometer tubes of the chlorine meter are removable. Chlorine is applied either through diffusors as a gas, or drawn into an injector, no solution jar being used. The injector is provided with vacuum relief, preventing moisture from being drawn up into the apparatus by the vacuum formed, due to the absorption of chlorine remaining in the machine when shut down. This, the manufacturer states, is an important improvement since so-called flooding has always been a serious factor in successful operation. A ball check valve is also provided as an additional precaution in case chlorine is applied into the main. These and other improvements have minimized the number of parts necessary.

The apparatus is mounted on a platform scale, as shown in the accompanying illustration of a unit installed at Norristown, Pa. This combined unit, it is pointed out, saves floor space and makes an attractive installation, chlorinator and scales having a finish of white vitrified enamel, readily washable. Apparatus may also be mounted on a white vitrified enameled pedestal. Either of these types insures accessibility for all parts of the unit.

All-Steel Cab for Excavator

An all-steel cab, protecting both machinery and operator, has just been made standard equipment on all ¾ and 1-yd. excavators manufactured by the Pawling & Harnischfeger Co., Milwaukee. The cab is provided with windows on each side so that the operator may operate the machine efficiently irrespective of weather conditions. A swinging steel door is placed at each side of the machine to give complete access

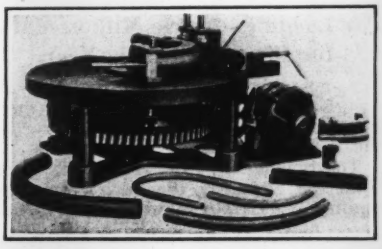


to all parts of the machinery. These doors are provided with latches and may be locked. The windows are protected by sheet-steel covers which may be slipped into place when the machine is not being used. A rolled sheet cover is placed over the drums and gears with a narrow slot for the cables to lead through, which eliminates the heavy door which was formerly used.

The capacity of the dipper on the P. & H. model 206 excavator has been increased to ¾ yd. struck measure instead of ¾ yd. heap measure.

Power-Driven Bending Machine

For bending pipe, tubes, conduits, reinforcement bars, angles, channels, tees and special sections the Wallace Supplies Mfg. Co., Chicago, has developed a new power-driven machine which, on account of its weight of 4 tons, may be transported from one job to another by motor truck. The capacity of the machine is ample for bending, cold, 4-in. pipe, two 1¼-in.



reinforcing bars at one time, or one 2½-in. bar, 4x4x½ angles or 6-in. channels.

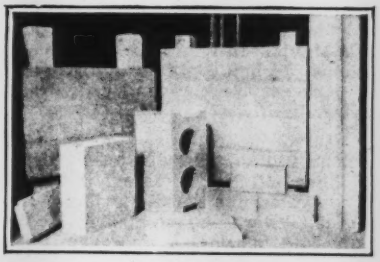
The machine operates in both directions, and it is, therefore, practical to make both right-hand and left-hand bends in reinforcement bars. This, however, applies only to bars, as pipes, angles, channels, tees, etc., on account of the tool equipment necessary for bending such shapes, can be bent only to the one hand and in order to get a reverse bend the material has to be removed and reinserted from the opposite end.

The machine, as shown, is equipped with a form for making a 90-deg. bend in a 4-in. pipe, but more than 90 deg. can be obtained either by resetting the material in the form and putting it through repeated operations, or by having the machine equipped, at slightly additional cost, with special form to suit the number of degrees of bend wanted.

The floor area required is about 6½x6 ft., and the height of the machine from top of floor to top of table is about 26 in., while height overall is 36 in.

Mineralized Sawdust Aggregate Makes Lightweight Concrete

By the use of mineralized sawdust for the aggregate, instead of sand or gravel, a new form of concrete called Novocrete, weighing only from one-half to two-thirds as much as ordinary concrete, has been developed by the Novocrete Co., New York. The applications of the material include both precast units, such as partition tile, roofing block, and floor tile, and monolithic construction, such as floors, sidewalks, and railway platforms. Novocrete "lumber" also is available for frame building



construction, sheetpiling, fence posts, etc.

The material, its manufacturer states, shows high resistance to wear, is fire resistant, less of a non-conductor of sound and more comfortable to walk on than ordinary concrete. It can be sawn, nailed, screwed and polished. Recent tests at Columbia University, New York, on standard briquets of a 1:3 mixture of cement and sawdust showed tensile strengths of from 300 to 400 lb. per square inch at 7 days and a compressive strength of 1,800 lb. per square inch at 28 days.

Additional tests showed that steel reinforcing rods embedded in Novocrete are perfectly protected, the chemicals used in mineralizing the sawdust having no detrimental effects on the steel. The cost of mineralized sawdust for making this form of concrete is said to vary from $2 to $3 per cubic yard depending on the distance from a source of supply of suitable quality.

Paint for Damp Surfaces

For coating damp or wet masonry the Truscon Laboratories, Detroit, have brought out a new paint called Stucco Tex. This material contains no oil whatever, it is produced in powder form and mixed with water much after the manner of calcimine or cold water paint. The color varieties include: white, cream, red, concrete gray, bedford gray, portland gray, tile red.

It must be borne in mind, the manufacturers point out, that Stucco Tex has no relation to an oil paint, nor to a cold water paint. It is usually used on cement and masonry surfaces, especially if they are wet, although it can be applied to a dry surface also. It is

an all inorganic material and non-perishable, containing no glue, casein or vegetable oils.

Publications from the Construction Industry

Municipal Castings—H. W. CLARK Co., Mattoon, Ill., has issued a 24-p. pamphlet on its municipal and miscellaneous castings including manhole covers and lids, cistern tops, coal chutes and frames, curb and gutter inlets and gratings, floor plates, and name plates and tablets; also traffic signs and a mushroom type illuminated traffic guide.

Rock Asphalt—UVALDE ROCK ASPHALT Co., San Antonio, Tex., has issued a 40-p. illustrated pamphlet on the use of Texas limestone-rock asphalt for paving streets and highways and for flooring warehouses and industrial plants. In its native condition the bitumen asphalt contains approximately 12 per cent bitumen and 88 per cent carbonate of lime.

Concrete Pipe Sewers — AMERICAN CONCRETE PIPE ASSOCIATION, Chicago, is distributing a 31-p. illustrated pamphlet on the design and construction of sewerage systems of concrete pipe, both reinforced and plain. The text includes reports on the condition of concrete pipe sewers in service many years. Other features are discharge diagrams for concrete pipe, and recommended practice for laying pipe.

Bituminous Pavement — WARREN BROS. Co., Boston, is distributing a 28-p. illustrated pamphlet describing Warrenite-Bitulithic pavement used for resurfacing worn out pavements or for new construction employing the so-called "black base." The pamphlet describes, also, the company's engineering and laboratory service in connection with the construction of highways. In the Warrenite-Bitulithic pavement emphasis is laid on the blending of the adjacent surfaces of two mixtures, coarse at the bottom and fine at the top to produce a single layer.

Rock Crusher — ALLIS-CHALMERS MANUFACTURING Co., Milwaukee, Wis., has issued a 16-p. illustrated bulletin on the McCully gyratory rock crusher for fine reduction. In this crusher the top shell is made reversible to obtain greater wear from the concaves which may be either of chilled cast iron or of manganese steel. Lubrication is effected by means of an oil pump. The crusher is built in two sizes, 6 and 10-in. feed openings. The capacities range from 24 tons per hour for a ¾-in. discharge opening on the smaller size to 135 tons per hour for a 2½-in. discharge on the larger size.

Wood Tanks—PACIFIC TANK & PIPE Co., San Francisco, has issued a new catalog of wood stave tanks for water, oil, fruit juices and chemical solutions. The line includes both circular and rectangular tanks. For extremely arid climates a special tank is made with a groove in the top of the staves through which water is fed and discharged through small holes to keep the entire tank moist. A number of the illustrations show elevated tanks up to 50,000 gal. capacity for fire protection purposes at industrial plants.

Street Lighting—KUHLMAN ELECTRIC Co., Bay City, Mich., has published an 18-p. illustrated pamphlet describing its transformers and their application in the Company's series multiple system of street lighting. In this system a small transformer is installed at each lamp resulting in a condition of high tension in the ground and low voltage up the pole. The main advantages of the system, it is pointed out, are safety and economy through the prevention of accidental burn-outs of lamps.

Sewage Pumps—DELAVAL STEAM TURBINE Co., Trenton, N. J., describes its sewage pumps in a pamphlet just issued. The pumps are of the single stage double suction type. For some conditions they are fitted with special open impellers which run close to removable side plates in such a way that the knife-like edges of the impeller blades will shear or cut stringy material. Due to the close clearance employed and the smooth surfaces of the side plates, the efficiencies obtained, it is claimed, are practically as high as those shown by enclosed impellers for similar heads, capacities and speeds.

Well Screens—EDWARD E. JOHNSON, INC., St. Paul, Minn., has issued a 78-p. booklet describing and illustrating brass screens for tube wells. Instead of many short, staggered slots the Johnson well screen has a spiral slot continuous from end to end and pitched 5½ turns to the inch. Practical hints are given on installation and maintenance of screens.

Centrifugal Pumps—KROGH MANUFACTURING Co., San Francisco, is distributing a folder in which are found a series of bulletins describing its centrifugal pumps for a wide variety of uses. The types include steel-lined dredging pumps in sizes from 2 in. up, equipped with renewable plates, deep-well turbine pumps, shaft-sinking pumps and a line of belted horizontal centrifugal pumps in which the feature is an automatic hydraulic balancing device which eliminates thrust bearings.

Eight-Yd. Power Shovel—MARION STEAM SHOVEL Co., Marion, Ohio, has just issued Bulletin 314 on its 8 cu.yd. steam and electric shovels, claimed to be the largest in the world. They are designed particularly for stripping overburden and other forms of heavy excavation. These shovels are equipped with a 90-ft. boom and a 56-ft. dipper handle. The working weight of the steam unit is 960,000 lb. and of the electric unit 910,000 lb. The shovels are supported by four-wheel trucks under each corner of the lower frame. A feature of the equipment is a patented hydraulic equalizing and leveling device for keeping the revolving frame level when operating on uneven ground.

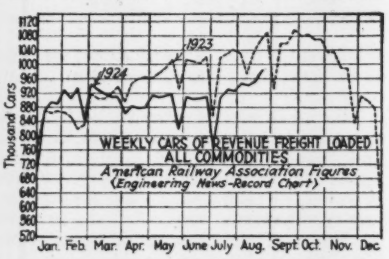
Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Car Loadings Above Million Mark for First Time This Year

A new high record for the year in freight car loadings was reached during the week of Aug. 30, according to the American Railway Association.

Total loadings for the week were 1,020,339 cars for the entire country, against 1,092,150 for the corresponding week in 1923 and 923,806 for the same period in 1922.



The carloading situation appears to be typical of business conditions generally. This year's volume is slightly below a year ago but heavier than 1922, or, for that matter, any previous year.

This is the season of the year when grain begins to start eastward and coal, in a westerly direction. Loadings of grain and grain products totaled 68,837 cars, while forest products, including lumber, required 69,252 cars during the week. Although every classification showed a gain except live stock, the bulk of the freight movement consisted of miscellaneous cargoes. Coal loadings were 168,584 cars.

This was the first time this year that the million mark was exceeded in any one week. During 1923, however, weekly loadings kept well above the million cars per week mark (holidays excepted) from May 24 to Nov. 15.

Steel Corporation Accepts Order To Abandon Pittsburgh Plus

The United States Steel Corporation and its subsidiaries filed an official report with the Federal Trade Commission, Sept. 17, 1924, in which the corporation and subsidiaries agreed to abandon the Pittsburgh Plus system without further litigation.

The order issued by the Commission, July 22, 1924, calling for the abolition of the Pittsburgh Plus system, was based upon the contention that the method was in violation of the Federal Trade Commission Act and also of the Clayton Act.

It is understood that the validity of the order is not admitted by the Steel Corporation, neither is the jurisdiction of the Commission to issue such an order. Prices in the future will be quoted f.o.b. mill, with only the actual freight charge to destination added.

Danger of Rise in Price of Brick

Early Closing of Yards May Cause Scarcity in Spring—Present Surplus Due to Steel Erectors Strike

The New York brick market, a year ago, was regarded by leading manufacturers as being the "strongest of all the Eastern markets." The situation today in New York City is quite the reverse.

The three factors responsible for the apparent oversupply of brick in this market and the abrupt drop in price from $23.65, as of July 3, 1924, to the present level of $17 per M. delivered at site of job, are: the steel erector's strike, effective May 1; unprecedented production program; and importation of the European product.

The strike of the steel erectors had the effect of suspending operations in the other building trades, particularly the bricklayers. Manufacturers had, early in the season, gauged their production schedules to accommodate the heavy volume of projected construction, which, held up by the steel erectors resulted in an accumulation of brick.

Importation Started Year Ago

For a full year, foreign brick have been penetrating the American market, mostly through the Port of New York. The gradual increase in receipts of foreign brick, added to the surplus already present, produced a reserve of almost 50,000,000 by the first week in September, 1924.

The brick situation as of Aug. 1, 1923, was described by the Common Brick Manufacturers Association of America in their bulletin of Sept. 1, 1923, as follows:

"For the first time during the business career of anyone now manufacturing brick some competition is felt from foreign made brick. This is apparent so far only in the New York market, where considerable quantities of brick from Germany and Holland are reported to be coming in. It is stated that these brick can be purchased on board ship at German and Holland ports for $4 a thousand. It is apparent at once that American manufacturers cannot compete with this low production cost even after transportation and handling on this side of the ocean has been absorbed. This competition is not likely to reach far inland, but would affect Atlantic ports unless the American manufacturers in those locations find some protection."

The situation as outlined above is contrasted with a report by the Association under date of Sept. 1, 1924, as follows:

"The only serious reaction in the market is found in Greater New York, where there is a decided slackening of new construction work. The price of brick wholesale in New York has dropped from $20 to $15 and some barges sold as low as $13 a thousand. This practically eliminates foreign brick from consideration, as the preference always has been for the American made product at anything like an equal price. It also eliminates the manufacturer's profit."

(*Continued on p. 528*)

Building Permits and Lettings Increase

Recovery From Midsummer Slump In Public and Industrial Buildings Seen—Private Projects Gain

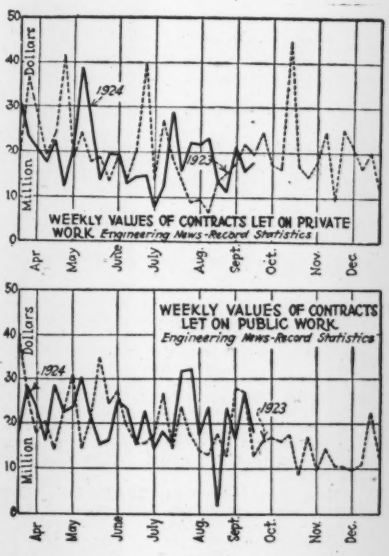
That the trend in public building and industrial construction has been upward since Sept. 1, is shown by the accompanying tabulation of weekly contracts awarded, as published in *Engineering News-Record.*

Minimum costs observed in the Construction News section of *E. N.-R.* in each class of construction are as follows: water-works and excavations, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

LARGE BUILDING CONTRACTS—NUMBER AND VALUE

Week Ended	Commercial: Public Work No.	Commercial: Public Work Thousand	Commercial: Private Work No.	Commercial: Private Work Thousand	Industrial Work No.	Industrial Work Thousand
July 31	16	$4,035	44	$11,314	21	$6,719
Aug. 7	12	4,672	37	18,026	26	2,965
Aug. 14	11	2,491	47	18,386	15	2,757
Aug. 21	7	1,381	45	13,959	20	3,493
Aug. 28	15	5,431	31	10,057	11	747
Sept. 4	8	2,974	39	18,488	30	2,532
Sept. 11	14	5,378	32	10,831	27	3,076
Sept. 18	20	6,209	28	12,545	20	4,893
Eight Weeks	103	$32,571	303	$113,606	170	$27,182

The recovery from the midsummer slump, however, has not been so noticeable in public work, all classes, as shown by the chart; although this type of construction is at present following very much the same trend as in 1923.



Public building awards for the week ended Sept. 18, were the heaviest in number since May 1 and in value, since July 24. Private commercial buildings have not shown the same recovery either in number or value.

The total of contracts awarded on large industrial projects for the week ended Sept. 18, was larger than for any week since July 31, although the actual number of lettings was below the average for the past eight weeks.

The four high peaks in the 1923 curve of private contracts let, are explained by the occurrence, during those particular weeks, of the following big awards:

1923	Project	Location	Value
Mar. 29	Railroad and telegraph system, 330-mi.	Montana	$12,000,000
Apr. 26	Sugar refinery	Texas City, Tex.	5,500,000
	Station, B. & A. R. R.	Springfield, Mass.	4,000,000
	Bank	St. Louis, Mo.	3,000,000
	Floating dry-dock	N. Vancouver, B. C.	3,750,000
June 28	Telephone exchange	New York City	11,250,000
	Two office-buildings	Chicago, Ill.	7,000,000
			5,500,000
	Office building	New York City.	5,000,000
Oct. 18	Power station	Kearny, N. J.	20,000,000

The two peaks reached so far this year were due to the following large contracts:

1924	Project	Location	Value
May 8	McCorkle pipe line	San Antonio, Tex.	$15,000,000
July 31	Subway	Philadelphia, Pa.	14,215,000

Taking the building outlook for the immediate future from the standpoint of permits issued, the survey prepared by S. W. Straus & Co., may be quoted as follows:

"Building permit reports from 330 cities and towns for August indicated that the trend toward stabilization, which had been evident in the construction industry for several months, continued to be the dominant feature. The total for the 330 cities and towns was $277,458,847 as against $269,373,230 last August and $264,376,450 in July this year, a gain of 3 per cent over a year ago and a gain of about 5 per cent over the previous month.

August Gain Unusual

"The month of August, with few exceptions during the past decade, has shown a decrease in building permits from July. The increase of about 5 per cent this year would, therefore, seem to point to a healthy condition in the building industry at large.

"It will be noted that taking the country by regions, every region showed some increase over July and only one, the Pacific West, failed to show an increase over August, 1923.

"The South continued to show unusual activity in the planning of new construction, with a gain of 46 per cent over last August and 15 per cent over this July. The East gained 3 per cent over August and 2 per cent over July, 1924. The Pacific West had a gain of 14 per cent over July.

"In the 25 leading cities (selected on a basis of volume of permits), the increase over last August was in keeping with the general stabilizing trend, the total being $173,204,314 against $173,195,515. The increase in these same cities this August was about 16 per cent over August, 1922. There was also an increase in these cities over July this year.

"New York City showed a loss of 33 per cent from August, 1923. Among the larger cities showing gains are: Miami, 482 per cent; Philadelphia, 179 per cent; Boston 162 per cent; New Orleans 126 per cent; Kansas City, Mo. 98 per cent; Buffalo 74 per cent; Milwaukee 44 per cent; Cleveland 20 per cent and Chicago 9 per cent."

Danger of Rise in Brick

(*Continued from p. 527*)

Up to May 1, of this year, New York had suffered from a brick scarcity which dated back to the first quarter of 1922.

The sudden glutting of this particular market resulted in the equally abrupt price decline. There are serious possibilities now at hand, however, which point toward higher price levels in the Spring or perhaps before that time.

Finding the market saturated, the yards in the Hudson River district have started to close down earlier than usual.

Brick production and transportation ceases almost entirely in the New York district, during the cold months of the year. Although production continues throughout the winter in the warmer sections of the country, transportation and handling costs prohibit the shipment of brick into this market from districts where there is never any shortage.

With the winter building idea becoming increasingly popular, the Fall and Winter demand combined will undoubtedly cause a scarcity in the Spring, unless a greater number of plants keep open or importations increase, in the near future. The new 1925 brick will not have entered the market to an appreciable degree much before June. The price, therefore, from present indications, does not seem destined to go below the existing level of $17 per M., delivered.

Bids wanted on big jobs—see Construction News Section, pp. 167 to 179, for details on the following:

Office, Brooklyn, N. Y., Chanin Constr. Co., $4,000,000.

Apartment Hotel, New York City, Lapidus Engr. Corp., $3,000,000.

High School, East Boston, Mass., City School House Dept., $1,300,000.

Medical Arts, San Antonio, Tex., by R. H. Cameron, archt., $1,000,000.

Large contracts let during week—see pp. 167 to 179, for following:

Power house, Providence, R. I., to D. E. McIntire, $2,500,000.

Town site, Belmont, Calif., to Industrial Eng. Corp., $1,500,000.

Store, Milwaukee, Wis., to S. M. Siessel Co., $1,500,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 4, the next, on October 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	$3.80	$4.20	$3.10	$3.35	$4.00	—$3.00	$3.35	$3.50
Structural rivets, 100 lb.	3.75	4.35	4.90	3.10	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.87½	3.35	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.05%	36%	36.80@49.10%	45%	37.83
Cast-iron pipe, 6 in. and over, ton.	—56.60@57.60	—54.50	—59.00	—56.20	55.50	68.00	—56.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	.2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.75	1.85	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	3.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	56.00	35.00	57.20	55.00	37.75	34.75	+34.00	26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.60	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.45	1.85	1.50	1.40	2.70	2.15	2.80	10.50
Common brick, delivered, 1,000	17.00	11.00	—11.90	12.00	14.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	—.094	.089	.08	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	—.094	.089	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	1.03	—1.12	1.20	1.05	—1.07	1.23	1.14	1.13	1.16
Common Labor:									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.40@.60	.82½	.50@.55	.35@.50	.50	.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.96. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

Aside from a slight decline in brick prices in Southern districts, the market for this commodity has shown increasing firmness since the first of the week.

The same is true of both pine and fir timbers, especially in New York. Hollow tile and c.-i. pipe, however, have each registered a slight general weakness since Sept. 18.

Linseed oil is weaker in the Middle West. Minneapolis reports a drop of 5c. per gal. during the week. The slight recession is due to the large quantities of new flaxseed now entering the market.

Although buying proceeds with a high degree of caution and for current requirements only, there is danger of freight congestion, owing to coal and grain movements; prompt shipments are, therefore, much in demand.

Improvement in demand is evident in railway materials, pig iron, brick, lumber, textiles and leather.

Pig iron is firm at $18@$18.50 per ton for No. 2 fdry, Southern. Slight improvement in iron buying has been noted during the week.

Weakness, however, continues in steel. Reinforcing bars touched a minimum of $2 per 100 lb., Pittsburgh, this week, with a maximum reached at $2.10. Structural shapes are $1.90@$2 and plates, $1.60@$1.90 per 100 lb., f.o.b. mill. Iron and steel scrap is advancing steadily.